AIRBORNE AUXILIARY POWER

The auxiliary power unit (APU) is used to generate and supply electrical power to supplement the engine generators or to perform maintenance on the airplane. The APU-driven generators are described in Chapter 24. Maintenance Practices that can be performed with the APU installed in the airplane are contained in this chapter. Maintenance for the APU, which is proprietary to the manufacturer, is covered in the Solar Maintenance Manual.

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"END"

PIEDMONT AIRLINES SUPPLEMENT LOG

SUBJECT APU

CHAPTER 49

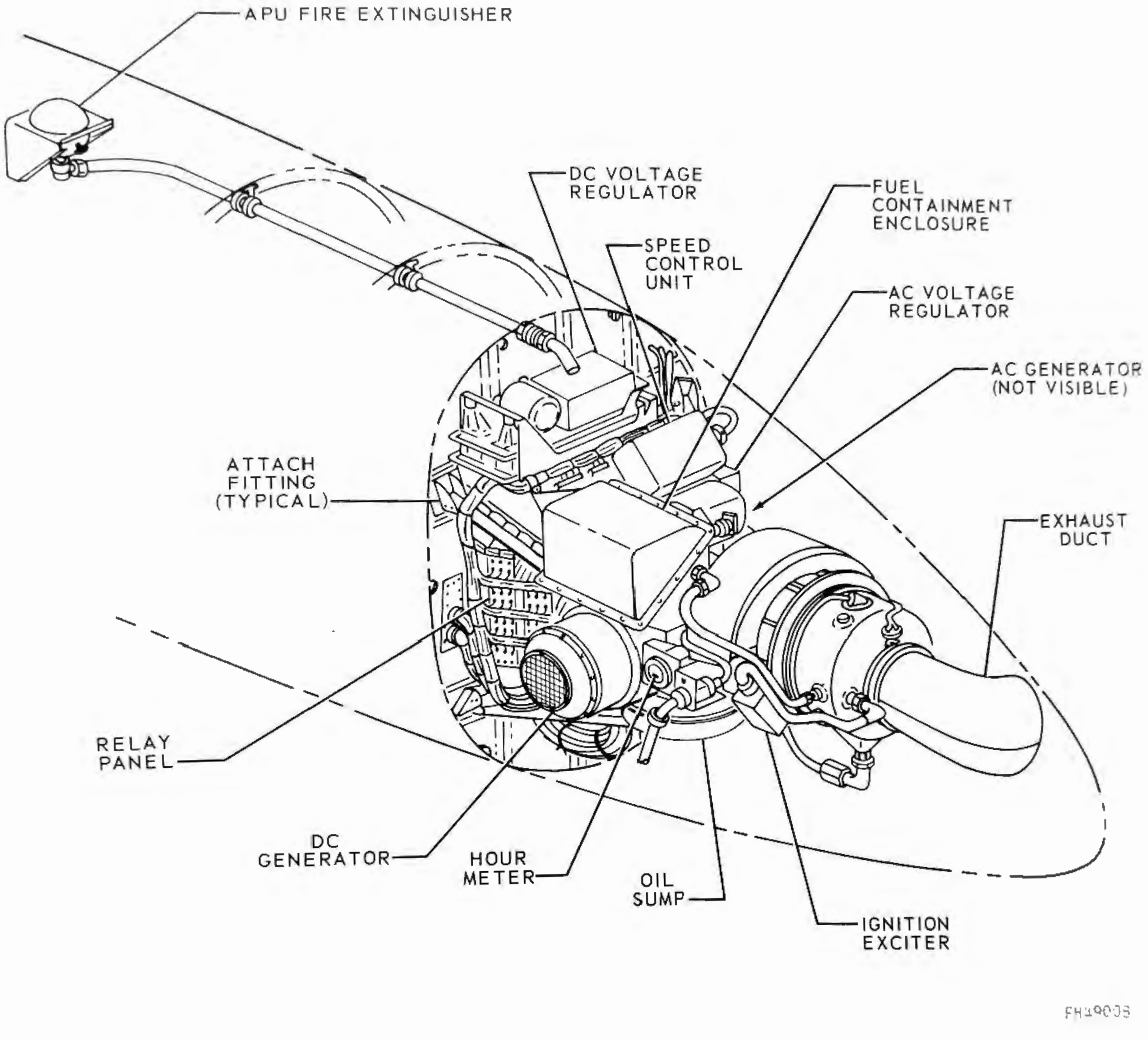
SUPPLEMENT NUMBER	ATA CODE	PAGE ADDED	EFFECTED MANUAL PAGE	DESCRIPTION	REFERENCE	DATE	APPROVAL
A	49-00	204A	204	APU - Maintenance Practices - Inspection	EA 227-149	6-26-70	JFW
A	49-50-0	A1	1	APU - Components - Inlet Screen	EA 227-149	6-26-70	JFW
A	49-50-0	A201	201	APU Air - Maintenance Practices - Removal/Installation - Inlet Screen	EA 227-149	6-26-70	JFW

DATE 6-26-70

AIRBORNE AUXILIARY POWER - GENERAL

1. DESCRIPTION.

A gas turbine APU in the right nacelle drives a dc generator which may be used to supplement 28-volt dc power to the flight emergency bus and a three-phase ac generator identical to the engine-driven deicing generators which may be used to supply power to the freon compressor or to restore deicing power lost by failure of either engine-driven deicing generator. Normally, the freon compressor will operate on power from the No. 2 engine-driven deicing generator when this generator is energized. Whenever the No. 2 engine deicing generator output is required for engine-propeller or windshield deicing, the freon compressor automatically selects the APU ac generator as a power source. Whenever the APU ac generator output is selected for deicing of either engine-propeller, the freon compressor is automatically deenergized. Either propeller-engine deicing system may be supplied from the APU, but an interlock circuit permits only the first selected system to draw power from the APU generator. Both APU-driven generators are voltage controlled and fault protected in the same manner as the engine-driven generators. Fire detection and fire extinguishing are provided in the APU compartment. An APU control panel is located in the center overhead area of the crew compartment, containing indicators which display operating conditions of the turbine and generators, and controls for operation of the system. Nine warning lights provide indication of APU fire, turbine overspeed, overtemp, low oil pressure, dc generator overheat and failure, and ac generator overheat, failure, and undervoltage. Illumination of the APU fire, turbine overspeed, or turbine overtemp light simultaneously sounds a warning horn and the APU automatically shuts down. Illumination of any of the remaining lights simultaneously illuminates the APU master warning light on the copilot's instrument panel. A fire extinguisher switch on the APU panel in the crew compartment simultaneously shuts down the APU and discharges the fire extinguisher bottle. An additional panel in the right nacelle provides APU fire warning and facilities for turbine shutdown, and fire extinguisher discharge during ground use. The auxiliary power unit is installed in the aft section of the right nacelle at station 225. Two electrical plugs, with mating receptacles in the station 225 firewall, provide a disconnect point for the electrical wiring to the APU. Fuel for the APU engine is taken from a connection to the right engine fuel line. The APU is mounted to the nacelle aft bulkhead by three support assemblies (left, right, and lower) which are steel tube weldments forming three sets of V-frames. The left and right supports are bolted to an aluminum trunnion support, which, in turn, is bolted to the 8000 rpm output pad. The lower engine support is bolted to the lower aft portion of the turbine assembly housing. The APU can be removed as a unit from the aircraft engine nacelle. Three



Auxiliary Power Unit
Figure 1

electrical accessory panels are installed on top, and on the sides of the engine support assemblies. Electrical system components, such as relays, current transformers, a resistor, a time delay relay, an RPM sensor, terminal boards, an ac voltage regulator and generator controls are installed on the panels.

2. COMPONENTS.

The APU installation consists of the auxiliary power unit, support structures, controls, fuel and electrical connections, and fire protection provisions.

A. Auxiliary Power Unit.

The auxiliary power unit consists of a turbine engine, reduction gearbox, an ac generator, a dc generator which is used as a motor for starting the turbine engine, tubular mounting supports, electrical wiring, and accessories for monitoring and controlling operation of the unit.

B. Master Control Panel.

A control panel is mounted in the flight compartment in the center overhead group of panels. The APU control panel contains the following controls and indicators.

(1) Turbine: warning horn, % rpm indicator, exhaust gas temperature indicator, overspeed warning light and test switch, overtemp warning light and test switch, low oil pressure warning light, start switch, reset switch, fire extinguisher warning light and test switch, and guarded fire extinguisher switch.
(2) DC generator: dc ammeter, overheat and failure warning lights, and generator control switch.
(3) AC generator: dual range ac ammeter, overheat failure and undervoltage warning lights, generator control switch, and ammeter phase selector switch.

C. Nacelle Control Panel.

Certain APU controls are mounted in the right nacelle for use by ground personnel. A fire warning light, and switches for fire detector system test, fire extinguisher, and turbine stop are provided.

D. Master Warning Light.

A master warning light is provided on the instrument panel directly in both pilots' field of vision. This light illuminates simultaneously with any APU generator warning light or the turbine low oil pressure light.

E. DC Generator Trip Switch.

The APU dc generator trip switch operates the same as the engine-driven dc generator trip switches. Refer to DC GENERATION, Chapter 24-30-2.

F. DC Power Master Switch (Crash Bar).

The APU generator trip switch is operated by use of the dc power master switch. Refer to DC GENERATION, Chapter 24-30-0.

G. Fuel and Electrical Connections.

Refer to 49-30-0 and ELECTRICAL POWER, Chapter 24.

H. Fire Detection and Extinguishing Provisions.

Refer to FIRE PROTECTION, Chapter 26.

3. OPERATING PROCEDURES.

NOTE: APU with aluminum compressor wheels should not be operated at ambient temperatures above ISA +23°C.

A. Preflight Procedure.

(1) Check for adequate fuel supply.
(2) Check lubricating oil supply (with dipstick) in oil pan. Replenish oil supply if necessary.
(3) Check plumbing and electrical wiring for security.
(4) Remove any loose objects or material from around unit, especially objects that may be ingested by engine during operation.

CAUTION: ALWAYS MAINTAIN A CLEAN ENGINE INSTALLATION. THE GREATEST HAZARDS TO A GAS TURBINE ENGINE ARE LEAKING FUEL CONNECTIONS, AND ENTRY OF FOREIGN MATERIAL INTO THE COMPRESSOR.

B. APU Temperature Warning Circuit Test.

NOTE: The APU should not be operating while testing the APU temperature warning circuit.

(1) APU turbine start switch - OFF.
All APU operation should begin with the APU turbine start switch OFF. The OFF position resets certain elements of the APU circuitry.

(2) APU turbine start switch - ON.
The APU turbine overtemp light should illuminate and the APU warning horn should sound. If it is desired to avoid this sounding of the warning horn, the reset switch should be held in RESET position while positioning the start switch from OFF to ON.

(3) APU turbine reset switch - RESET, then NORMAL.
The overtemp light should go out and the warning horn should silence.

(4) APU turbine overtemperature test switch - TEST.
The switch should be held in the TEST position until the APU turbine temperature indicator displays approximately 500° F.

(5) APU overtemperature test switch - NORMAL.
Monitor the temperature indicator. As temperature falls below approximately 400° F, the APU turbine overtemp warning light will illuminate and the APU warning horn will sound. Actually this test checks the "flame-out" (undertemperature) aspect of the temperature warning circuit.

(6) APU start switch - OFF.
The overtemp warning light should go out and the warning horn should silence.

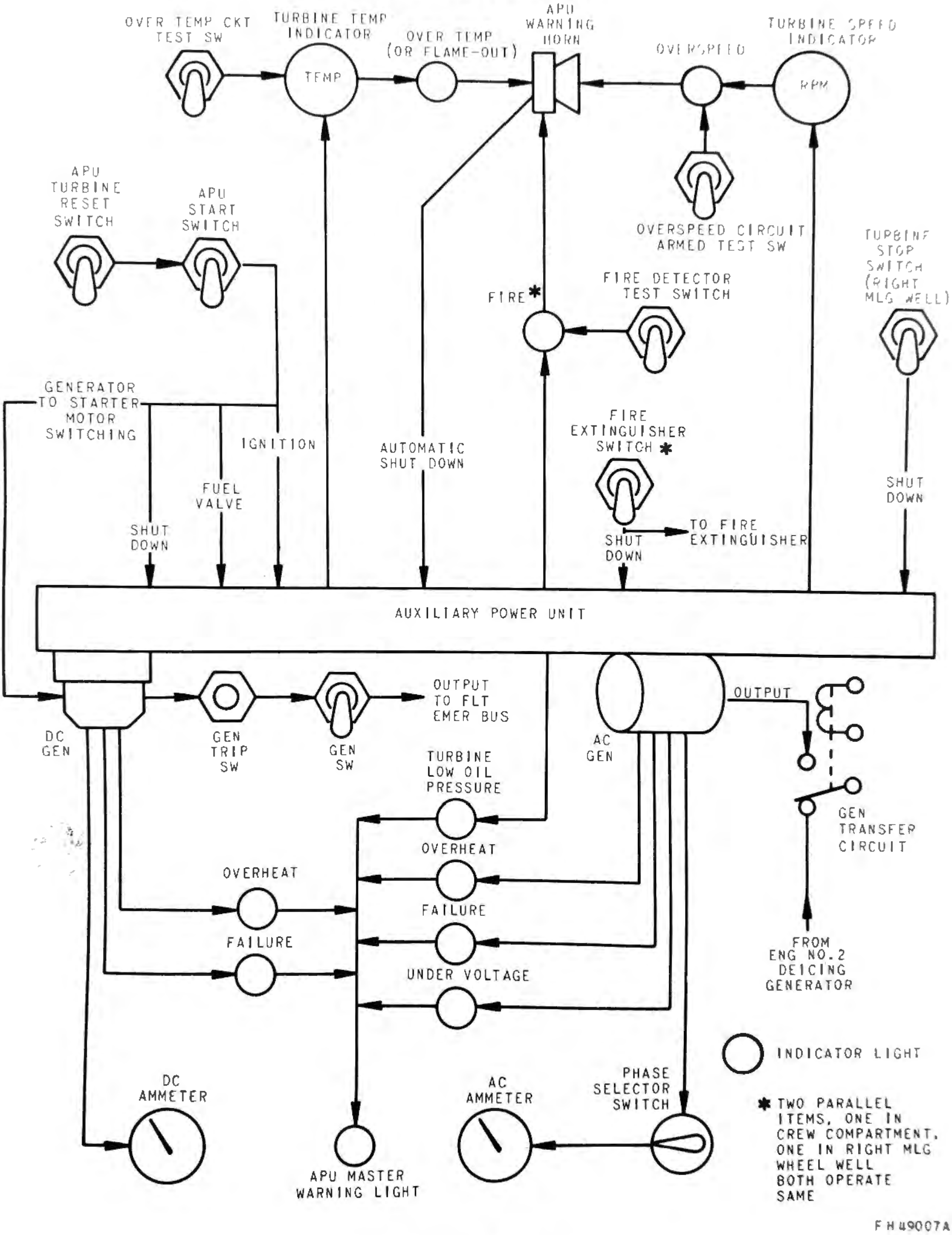
C. Fire Warning System Test.

(1) Fire test switch - TEST.
Fire warning light should illuminate.

(2) Fire test switch - NORMAL.
Fire warning light should extinguish.

D. Warning Lights Test.

(1) Press to test all APU warning lights.



APU Flow Schematic
Figure 2

E. Starting Procedure.

NOTE: Do not operate the auxiliary power unit above 21,000 feet altitude.

A right fuel boost pump should be operating to supply fuel pressure, during operation of the APU.

Do not start the auxiliary power unit with load applied to the ac generator.

(1) APU manual shut-off valve - open.
(2) All APU switches - OFF or NORMAL.
APU operation should begin with the control switch in the OFF position to reset certain elements of the system.
(3) APU turbine start switch - ON.
(4) APU turbine reset switch - RESET, then NORMAL.
(5) APU turbine start switch - START, then RUN.
If no light-off occurs, turbine speed will hang at 40% to 50% rpm. Observe both RPM meter and temperature indicator during engine acceleration. During a normal start, RPM meter should indicate a constantly increasing speed until approximately 102 percent is reached.

CAUTION: LIMIT STARTING CRANK TIME TO TEN SECONDS.

BE PREPARED TO SHUT DOWN THE ENGINE IF THE RPM METER SHOWS A DECLINE IN ACCELERATION RATE, OR IF THE TEMPERATURE INDICATOR SHOWS EXCESSIVE TEMPERATURE.

NOTE: Normal starter performance, assuming no light-off, will deliver a minimum of 20% engine rpm in less than two seconds. Starter performance less than this is reason for inspection or replacement of the starter.

(6) Should APU fail to start, position the start switch to OFF. Do not attempt an engine restart until the RPM meter reads zero rpm for at least a timed sixty seconds to permit fuel drainage. This action will avoid overheat damage from loaded combustor. If APU will not start on second attempt, note APU as inoperable and determine cause.

F. APU Overspeed Warning Circuit Test.

NOTE: The APU must be operating while testing the overspeed warning circuit. The test checks arming of the circuit only, and does not automatically shut down the APU.

(1) APU turbine overspeed test switch - TEST.
The APU turbine overspeed warning light should illuminate and the APU warning horn should sound.

(2) APU turbine overspeed test switch - NORMAL.
The overspeed warning light should go out and the warning horn should silence.

G. APU Electrical Generators Operation.

NOTE: Do not turn on electrical generators until APU is operating at rated speed.

(1) APU dc generator switch - RESET, then ON.
Observe dc ammeter to determine load on generator.

(2) APU ac generator switch - ON.
Observe ac ammeter to determine load on generator. Current in each of the three phases may be checked at any time using selector switch. Switch on front of ac ammeter should be left in the 50A position except when specifically checking for known low amperage loads.

(3) To remove either generator from its respective bus, place corresponding generator control switch to OFF.

H. Operating Limitations.

During engine operation, ensure that the following limitations are not exceeded.

(1) Rated Speed.

One hundred percent rated speed of the gas turbine engine is 56, 695 rpm, corresponding to 8000 rpm and 7788 rpm output speeds, and 4130 rpm tachometer generator speed. The rpm sensor is set to shut down the engine at 110 percent rated speed.

(2) Exhaust Gas Temperature.

The maximum allowable exhaust gas temperature during start must not exceed 1040° F. The maximum allowable exhaust gas temperature during steady state operation shall not exceed 1025° F. A thermocouple is installed in the unit and, in conjunction with the temperature indicator and pyrometer, automatically shuts down the engine in the event of an overtemperature condition. The temperature indicator and pyrometer is set to actuate at 1040°F. If automatic engine shutdown does not occur within five seconds at 1040°F, the engine must be shut down manually.

(3) Oil Pressure.

Oil pump pressure at rated engine speed is 15 to 40 psig. An oil pressure indicator is not provided on the unit; however, a low oil pressure switch is installed to warn of low oil pressure if the lubricating oil pressure decreases below 6 ± 1 psig. A red LOW OIL PRESSURE light on the cockpit control panel illuminates when oil pressure decreases to 6 ± 1 psig.

I. Normal Shutdown.

(1) AC generator control switch - OFF.
(2) DC generator trip switch - TRIP.
(3) DC generator control switch - OFF.
(4) Engine control switch - OFF-STOP.
(5) APU manual fuel shut-off valve - As required.
Manual fuel shut-off valve should be closed for maintenance, open if preparing airplane for operational status.

J. Malfunction Action.

(1) If low oil pressure light illuminates, shut down engine following normal shutdown procedure.
(2) If dc generator failure light illuminates, indicating a dc generator or regulator malfunction, place dc generator control switch in OFF and determine cause of malfunction.
(3) If dc generator overheat light illuminates, indicating that a preset temperature is being exceeded in dc generator, place dc generator control switch in OFF and determine cause of overheating.
(4) If an ac generator failure light illuminates, indicating an ac generator or regulator malfunction, place ac generator control switch in OFF and determine cause of malfunction.
(5) If an ac generator overheat light illuminates, indicating that a winding temperature of 374°F is being exceeded in ac generator, place ac generator control switch in OFF and determine cause of overheating.

(6) When ac generator voltage drops below 90 volts line-to-neutral or 165 volts line-to-line, indicated by illumination of an undervoltage light, place ac generator control switch in OFF-RESET; then move switch back to ON. If undervoltage light illuminates again, place switch in OFF and determine cause of malfunction.

K. Automatic Protective Shutdowns.

Protective devices in the electrical circuit monitor turbine exhaust temperature and engine speed. The operations of these devices are described in the following paragraphs.

CAUTION: DO NOT ATTEMPT TO OPERATE THE ENGINE BY WIRING AROUND OR OPENING CIRCUITS TO THE SHUTDOWN OR WARNING DEVICES. A CONDITION THAT PRODUCES AUTOMATIC SHUTDOWN OR WARNING DESERVES IMMEDIATE ATTENTION BECAUSE THIS PROTECTION IS INCORPORATED TO PREVENT DAMAGE TO THE ENGINE.

(1) High EGT.

When engine exhaust temperature reaches 1040°F, the pyrometer relay contacts open, electrical power to engine control circuits is disconnected, the main fuel solenois valve closes, a red overtemp light on the cockpit control panel illuminates, the warning horn sounds, and the engine is shut down.

(2) Engine Overspeed (110 Percent Speed).

When engine overspeed occurs, the overspeed circuit opens, electrical power to the engine control circuits is disconnected, the main fuel solenoid valve closes, a red OVERSPEED light on the cockpit control panel illuminates, the warning horn sounds, and the engine is shut down.

(3) Flameout.

When engine exhaust gas temperature drops below 400°F, the pyrometer relay contacts open, electrical power to the engine control circuits is disconnected, the main fuel solenoid valve closes, a red overtemp light on the cockpit control panel illuminates, and the warning horn sounds.

NOTE: While not a protective shutdown, flameout is a condition where the fuel-air mixture ceases to burn in the combustor. When this condition occurs in the pyrometer relay 400° F contacts open, deenergizing the circuit that controls the main fuel solenoid valve; the valve closes to prevent fuel from being injected into the combustor. If flameout recurs, refer to operating instructions and troubleshooting.

L. Emergency Shutdowns.

Emergency shutdowns are accomplished through the actuation of a stop switch located on the nacelle control panel, and fire extinguisher switches located on the cockpit and nacelle control panels in the event of a fire.

"END"

AUXILIARY POWER UNIT - TROUBLE SHOOTING

AUXILIARY POWER UNIT - TROUBLE SHOOTING.

Trouble	Probable Cause	Remedy
A. Engine does not crank.	1. No power to electrical system.	Check electrical circuit to ensure that electrical power is available at the starter.
	2. Loose electrical connections.	Check and tighten any loose electrical connection.
	3. Defective starter dropout contactor.	Replace if defective.
	4. Starter-generator.	Check brushes and starter-generator assembly.
	5. Seized engine.	Reach up tailpipe and turn rotor by hand. If seized, replace APU.
B. Engine cranks, but combustion does not occur.	1. No fuel supply.	Check that fuel is available to the APU at 5 to 40 psig.
	2. No fuel at start fuel nozzle.	Check that 28-volt dc power exists at start fuel solenoid valve. If power exists, check for plugged start fuel nozzle, defective ignition exciter, spark plug, or defective fuel pump. If none of these are at fault, replace the solenoid valve.

Trouble	Probable Cause	Remedy
B. Engine cranks, but combustion does not occur. (Cont)	3. No electrical power at fuel solenoid valve.	Check electrical system for loose connections. Check fuel pressure switch. Replace if defective.
	4. The ignition system is defective.	a. Ensure that 28-volt dc power is available at the exciter. If power is not available, check the electrical circuit. b. Use a jumper cable to supply power for a system check of exciter and spark plug. c. Listen for a "snap." If no snapping is heard, replace spark plug or ignition exciter, as applicable.
	5. Plugged start fuel nozzle.	Replace start fuel nozzle.
	6. Inadequate fuel supply to start fuel solenoid valve.	a. Ensure that minimum fuel pressure of 5 psig is being supplied to fuel pump. b. Check fuel pump filter. Replace if necessary. c. Ensure that fuel line to start fuel nozzle is clear.

Trouble	Probable Cause	Remedy
B. Engine cranks, but combustion does not occur. (Cont)		d. Remove fuel control assembly and check for a sheared fuel pump drive shaft. If pump drive shaft is sheared, replace spline adapter.
	7. Acceleration control assembly malfunctioning or out of adjustment.	Adjust or replace fuel control assembly.
C. Ignition and combustion occur, but engine does not accelerate.	1. Main fuel solenoid valve does not open; thus no fuel to main fuel injectors.	a. Ensure that 28-volt dc power is available to the solenoid valve. If power is available, the valve is burned out or mechanically blocked. Replace valve.
		b. If power is not available, check electrical circuit.
	2. Inadequate fuel supply.	a. Ensure that minimum fuel pressure of 5 psig is being supplied to fuel pump.
		b. Fuel inlet filter, or fuel pump filter may be plugged or iced; clean in warm fuel if necessary.

Trouble	Probable Cause	Remedy
C. Ignition and combustion occur, but engine does not accelerate. (Cont)		c. Check for restrictions in main fuel supply line, fuel line assemblies, fuel manifold assembly, main fuel injectors, and start fuel nozzle.
	3. Acceleration control assembly malfunctioning or out of adjustment.	a. Increase acceleration schedule in 1/8-turn increments. CAUTION: The acceleration adjustment screw can be easily damaged by overtightening locknut. Tighten locknut 1/8-turn beyond finger-tight. b. Replace fuel control assembly.
	4. Compressor pressure line cracked or loose, causing lack of compressor pressure to acceleration control assembly.	Tighten or replace compressor pressure line, as necessary.
D. Ignition and combustion occur, but engine does not accelerate. Overtemperature shutdown occurs, or exhaust rumbling is heard.	1. Compressor air inlet or turbine exhaust outlet is restricted.	Remove restrictions.
	2. Engine loaded prior to attaining 100 percent rated speed.	Remove load.

Trouble	Probable Cause	Remedy
D. Ignition and combustion occur, but engine does not accelerate. Overtemperature shutdown occurs, or exhaust rumbling is heard. (Cont)	3. Failure in engine resulting in increased drag.	Listen for unusual noises in reduction drive assembly or turbine rotor assembly.
E. Ignition and combustion occur, but overtemperature shutdown occurs or exhaust rumbling is heard on acceleration.	1. Compressor air inlet or turbine exhaust outlet is restricted.	Remove restrictions.
	2. Engine loaded prior to obtaining rated speed.	Remove engine load.
	3. Residual fuel remains in combustor.	a. Check combustor drain valve for obstructions. b. Check for defective main or start fuel solenoid valve.
	4. Acceleration control assembly out of adjustment.	Decrease acceleration schedule.
	5. Failure in engine resulting in increased drag.	Listen for unusual noises in reduction drive or turbine assembly.
F. Engine shuts down during acceleration.	1. High exhaust temperature causes shutdown through the temperature indicator and relay (pyrometer).	a. Check for cause of of high temperature per trouble D and E. b. Check the temperature settings (1025 to 1040° F) of the temperature indicator and relay.

Trouble	Probable Cause	Remedy
F. Engine shuts down during acceleration. (Cont)		c. Check the electrical circuit.
		d. Repair or replace thermocouple or temperature indicator and relay.
	2. Overspeed occurs from fuel control overshoot.	a. Residual fuel remains in combustor.
		b. Acceleration schedule set too high.
		c. Rated speed setting set too high.
		d. Check the electrical circuit.
		e. Replace acceleration control assembly.
	3. Inadequate fuel supply.	a. Check for cause of inadequate fuel supply.
		b. Check for a sheared fuel pump spline adapter.
		c. Check the electrical circuit.
Engine will not support load or shuts down.	1. Inadequate fuel supply.	a. Check for cause of inadequate fuel.
	2. Restriction in compressor air inlet or turbine exhaust causes overtemperature shutdown.	Remove restriction.

Trouble	Probable Cause	Remedy
G. Engine will not support load or shuts down. (Cont)	3. Failure in engine, resulting in increased drag.	Listen for unusual noises in reduction drive assembly or turbine rotor assembly.
	4. Engine overloaded, and overtemperature occurs.	Remove overload. Check for mechanical restrictions.
	5. Faulty temperature indicator and relay causes engine to shut down at low exhaust temperatures.	Replace temperature indicator and relay.
H. Engine shuts down because of overspeed.	1. Fuel control assembly malfunctioned.	a. Decrease rated speed setting on acceleration control assembly. b. Replace fuel control assembly.
	2. Overspeed setting too low.	Adjust or replace acceleration control as required.
	3. Acceleration malfunctioned.	a. Replace acceleration control. b. Check electrical circuit.
	4. Start fuel solenoid valve does not close at approximately 80 percent engine speed.	Replace valve.

Trouble	Probable Cause	Remedy
I. Engine will not shut down.	1. Mechanical malfunction in main fuel solenoid valve.	a. Shut off master switch. b. Shut off fuel supply. Repair or replace solenoid valve.
	2. Stop switch defective.	Shut off electrical power to engine. Replace stop switch.

"END"

AUXILIARY POWER UNIT - MAINTENANCE PRACTICES

CAUTION: THE PRECISION FINISHES AND CLOSE CLEARANCE OF PARTS MAKE IT ABSOLUTELY NECESSARY TO CAP LINES, AND PLUG INLETS AND OUTLETS TO AVOID ENTRY OF FOREIGN MATERIALS WHILE PERFORMING MAINTENANCE PROCEDURES.

1. PREVENTIVE MAINTENANCE.

A. General Precautions.

Observe the following precautions when performing maintenance on APU.

(1) Pay particular attention to detail during assembly.
(2) Exercise extreme care to prevent entrance of dirt, dust, or foreign particles into unit during assembly. If a foreign particle is dropped into unit, stop assembly until particle is located and removed. For added protection, cover large openings with cardboard and tape; small openings with tape or clean cloth. Cap open tube ends; do not use tape. If unit is to be left for even a short period in a partially disassembled state, cover all openings.
(3) If any parts were coated with corrosion-preventive compound, remove all traces of this compound and any accumulated foreign matter.
(4) Before assembling any part, ensure that part is thoroughly clean. Wipe all parts and surfaces with a clean, lint-free cloth.
(5) When installing gaskets on mating flange faces, coat surfaces with petroleum jelly. When installing fittings, bolts, studs, nuts or screws, coat all threaded surfaces with antiseize compound, FEL-PRO, or equivalent.
(6) When splines or gear teeth are mated, lubricate mating surfaces with lubricating oil.
(7) Replace all gaskets and O-rings (preformed packings) unless instructed otherwise. When installing O-rings and seals, lubricate surfaces with petroleum jelly. Avoid excessive stretching, scratching, pinching, and cracking. Do not slide or roll the O-ring over a threaded surface; protect O-ring by covering threads with paper or other material.

(8) Do not use a lead pencil or similar material to mark on stainless steel. When inspection marking is necessary, use chalk or a grease pencil for this purpose, but be sure to clean the part prior to installation. Do not use antiseize compounds containing graphite. Graphite particles carburize stainless steel at high temperatures.

(9) Do not use zinc-plated parts to scrape stainless steel parts. When such parts must be scraped, use stainless steel wool. Zinc deposits of any form on stainless steel will result in rapid corrosion at high temperatures.

B. Lockwiring.

(1) All parts lockwired prior to removal or disassembly must be lockwired with new wire in the same manner upon reassembly or installation.

(2) For general applications, use lockwire, MS20995C32 (0. 032-inch diameter, stainless steel) in all locations accessible for routine servicing procedures, with the following exceptions. Use lockwire, MS20995C47 (0. 047-inch, stainless steel) for securing the air inlet screen around the air inlet opening. Use lockwire, MS20995C20 (0. 020-inch diameter, stainless steel) for number 8 or smaller screws, for electrical harness coupling nuts, and in other tight places where it is not practicable to use 0. 32-inch diameter wire.

(3) Lockwire all drilled bolt heads, plugs, screws, etc., except those with self-locking nuts or lockwashers. Bolts should be lockwired in pairs where possible. When reassembling, be sure to replace lockwire wherever it was removed.

C. Periodic Inspection.

General inspections of the APU should be performed at intervals. Frequency of such inspections may be determined from the equipment manufacturer's recommendation.

COMPONENT	NATURE OF INSPECTION
Engine Harness	Visually check for loose or frayed wires. Check for rubbing or chafing. Check condition of connections. Check attaching points for security.
Engine Assembly	Visually check complete engine externally for fuel and oil leakage. Check for obstructions in air inlet, exhaust, and drains.
Fuel, and Compressor Pressure Lines	Visually check for bends, dents, breaks, and loose connections.
Oil Level	Visually check oil level with dipstick for proper quantity.
Fuel Filters	Remove fuel pump filter. Visually check for contamination. Clean filter, and check for damage. Inspect external (inlet) fuel filters for contamination. Clean or replace filters as required.
Attachment Bolts and Screws	Check attachment bolts and screws for proper torque. Tighten bolts and screws to standard torque values except for those requiring special torque values. Replace damaged lockwire, and damaged or fatigued lockwashers.
Electrical Wiring	Visually check all wiring, taking particular care to look for early signs of corrosion, or terminals or plugs that may have loosened from vibration. Replace oil- or fuel-soaked wiring, or wiring that appears to have deteriorated from heat. Tape and varnish any unraveled insulation or terminal ends.
Housings, Covers, and Brackets	Visually check for cracks, dents, deformation, or other damage that may affect strength or performance.
Spark Plug	Visually check for cracked or eroded insulator, eroded or corroded electrode.

COMPONENT	NATURE OF INSPECTION
Fuel Drain Valve Assembly	Remove and visually check for cleanliness and obstructions.
Lubricating Oil	Drain the oil sump, and replenish with lubricating oil.
Oil Filter	Replace with new oil filter.
Vane Clearance	Check clearance between exducer vanes and turbine nozzle with wire gage. If clearance is 0.014 inch, or less, return APU for overhaul.
Air Inlet	Visually check air inlet and compressor wheel for damage. As much of air path as can be observed should be checked. If severe scratches, or effects of erosion are found, return the APU for overhaul.

D. Torque Values.

Standard torque values are to be used for tightening all nuts and bolts except as noted below. Torque loads are given in pound-inches. Minimum and maximum figures represent the limits of the tightening range.

SPECIAL TORQUE VALUES

COMPONENT	MINIMUM	MAXIMUM
Combustor Clamp	50 lb in.	50 lb in.
Combustor Liner Locating Pins	30 lb in.	45 lb in.
Main Fuel Nozzles	30 lb in.	45 lb in.
Turbine Assembly Attaching Bolts	50 lb in.	70 lb in.

TITLE: AUXILIARY POWER UNIT - MAINTENANCE PRACTICES

SUBJECT: INSPECTION

FILING: Insert This sheet facing page 204, chapter 49-00 (dated Apr. 15-67, X-3). Do not remove any manual pages as a result of this supplement.

REFERENCE: E.A. 227-149.

REASON: This supplement is issued to show additional inspection procedures since the addition of an air inlet screen.

In paragraph 1, "PREVENTIVE MAINTENANCE," item "C", add the following at the end of the inspection items list:

COMPONENT	NATURE OF INSPECTION
Air Inlet Screen	Check screen for general condition. Thoroughly clean all foreign matter from screen before reinstallation. Make certain screen is properly secured.

E. Cleaning of Components.

Correct and thorough cleaning of all engine parts is important to successful inspection, repair, and satisfactory operation. When considerable time may elapse between cleaning or inspection and reassembly, place cleaned parts in clear plastic bags to prevent corrosion or contamination.

NOTE: Cap electrical connectors before cleaning.

COMPONENT	CLEANING METHOD	CLEANING MATERIAL
Fuel Pump Filter	Wash and flush then ultrasonic clean.	Stoddard Solvent, or equivalent.
Fuel Control	Wipe with clean, lintless cloth soaked in solvent.	Stoddard Solvent, or equivalent.
Start Fuel Nozzle	Ultrasonic clean.	Stoddard Solvent, or equivalent.
Oil Pressure Switch	Wipe with clean, lintless cloth soaked in solvent.	Stoddard Solvent, or equivalent.
Thermocouple	Wipe with clean, lintless cloth soaked in solvent.	Stoddard Solvent, or equivalent.
Ignition Exciter	Wipe clean with lintless, dry cloth.	Do not use solvent.
Hour Meter	Wipe clean with lintless, dry cloth.	Do not use solvent.
Spark Plug	Use a dry, fiber hand brush and wipe with clean, lintless, dry cloth.	Do not use solvent. CAUTION: Do not use conventional abrasive spark plug cleaners.

COMPONENT	CLEANING METHOD	CLEANING MATERIAL
Fuel Lines	Force-flush thoroughly and dry with dry, compressed air.	Stoddard Solvent, or equivalent.
"CB" Fire Extinguisher Fluid	Absorb with cloth.	Dry with clean, dry air or nitrogen.

2. CLEANING APU AIR INLET AND COMPRESSOR.

CAUTION: THE FOLLOWING INFORMATION IS THE SOLAR RECOMMENDED PROCEDURE FOR INTERNAL CLEANING OF THE APU AIR INLET AND COMPRESSOR. THIS CLEANING PROCEDURE IS RECOMMENDED TO BE ACCOMPLISHED AFTER 50 HOURS OF OPERATION, OR ONCE EVERY WEEK.

A. Obtain Materials.

(1) For each wash cycle: One pint RX2166 Carbon Cleaning Compound, manufactured by the T.O. Bateman Company, 3596 California Street, San Diego, California 92101.

NOTE: An alternate solvent/cleaner may be used after express permission is gained from the Solar cognizant Project Engineer. Exact composition, particularly the amounts of sulphur and phosporous contained in the alternate solvent/cleaner, must be determined and the information forwarded with the request for permission to use the material.

(2) Solvent spray gun.
(3) Paint mask.
(4) Distilled or soft water (approximately two quarts).
(5) Jumper wire for connecting pins A and B of fuel pressure switch connector plug.

B. Cleaning.

(1) Remove the right tail cone and stow in a safe place.
(2) Disconnect combustor drain flexible line at connection to check valve under turbine combustor.

(3) Disconnect connector plug from fuel pressure switch; jumper pins A and B of connector plug. (This action simulates the closed contacts of the fuel pressure switch and prevents ignition and actuation of the solenoid valves).

(4) Disconnect flexible air line, P/N 3301-23, from top of compressor housing.

(5) Prepare spray equipment; charge with one pint of cleaning compound.

(6) At control panel, move APU start switch to START and release. When RPM reaches 10 percent, move APU start switch to OFF.

(7) At turbine air inlet, spray cleaning compound into air inlet muff while engine is cranking.

NOTE: Cleaning compound that is ingested during the slow rotation of the turbine will be the most effective in the cleaning operation.

(8) Repeat cranking operation until the entire pint of cleaning compound is used.

(9) Allow APU to stand for 10 to 20 minutes to allow oil/dust deposits to be disolved.

(10) Charge spray gun with one quart of distilled water.

(11) Repeat step 6 spraying distilled water into air inlet muff.

NOTE: Water sprayed during slow rotation of the turbine is the most effective in the cleaning operation. Solvent will turn white in presence of water.

(12) Repeat cranking operation until entire quart of distilled water is used.

NOTE: An APU that has not been cleaned for 50 or more hours of operation may have heavy contamination and require a second cleaning. An APU that is extremely contaminated may require removal of combustor for removal of excessive deposits; refer to Solar Operation and Maintenance Instructions for approved procedures.

C. Reassembly.

(1) Inspect combustor drain check valve and clean as required.

(2) Connect combustor drain flexible line.

(3) Connect compressor discharge flexible line at top of compressor housing.
(4) Remove jumper from harness connector and reconnect harness to fuel pressure switch.
(5) Inspect APU thoroughly for loose connections and security of all fasteners.
(6) Install nacelle tail cone; make applicable APU log book entry.

3. CORRECTIVE MAINTENANCE.

Corrective maintenance of the gas turbine engine consists of removal of engine components, inspection, minor repair, adjustment, and replacement of engine components or accessories.

Whenever an accessory or component is removed for corrective maintenance or replacement, all parts that are removed to gain access to the accessory or component should be given a thorough visual inspection to determine serviceability and need for repair or replacement.

Note the location and approximate angular position of fuel line fittings before transferring them from a removed accessory to the replacement unit. This facilitates reassembly and minimizes strains when reconnecting the lines.

After performing any work on the fuel system that may have allowed air to enter the system, purge the fuel system if the engine will not start in three attempts.

Refer to the appropriate sections of this chapter for corrective maintenance procedures for selected components.

4. REMOVAL/INSTALLATION AND ALIGNMENT - APU.

A. Removal. (APU to be reinstalled before flight.)

(1) Remove the right tail cone.
(2) Disconnect the electrical connections at station 225 bulkhead left side.
(3) Disconnect ground wires at station 225 bulkhead.
(4) Identify, label and disconnect wires from start/dropout relay.
(5) Turn manual shut-off valve, located in nacelle, to OFF; disconnect and cap fuel line at station 225 bulkhead.

(6) Disconnect and cap fuel drain and gearbox vent lines at station 225 bulkhead.
(7) Use two web straps and hoist, or other appropriate support for the APU.
(8) Remove cotter keys, nuts, washers, and four clevis bolts from attach fittings at station 225 bulkhead.
(9) Remove the APU.

Removal. (Airplane to be flown without APU)

NOTE: It is mandatory to comply with your minimum equipment list when operating without APU installed.

(1) Disconnect, cap and stow electrical connector from fire extinguisher bottle; disconnect and cap fire extinguisher line from fire extinguisher bottle.
(2) Disconnect and cap fuel line; pressure check for leakage at cap. Turn manual shut-off valve, located in nacelle, to OFF.
(3) Disconnect, cap and stow all electrical connector at firewall.
(4) Disconnect, tape and stow wires P115A2, P115B2, P115C2 and P115D2 at junction box.
(5) Disconnect, tape and stow all wiring at APU unit; accomplish steps (6), (7), (8), and (9) preceding paragraph.
(6) Trip all circuit breakers associated with the APU, except APU DC GEN RESET circuit breaker.
(7) Fabricate a harness assembly, consisting of plug, P/N CA3106-KE36 with one wire connected to pin m and long enough to reach a suitable grounding point on the APU firewall. Install harness assembly in place of plug P102, which is removed with the APU, and connect to suitable ground.
(8) Placard APU control panel in flight compartment as APU INOPERATIVE - APU REMOVED.
(9) Placard APU generator switch, on right overhead panel, APU INOPERATIVE - APU REMOVED.
(10) Compute new center of gravity limits for airplane flying without APU installed.

Example:
C. G. change based on MSN 517 at 28,583 pounds (21% MAC) includes pilot, copilot and oil.
APU weight = 278 pounds.
APU removed moves C. G. forward 1.2%.

B. Installation.

(1) Locate the APU into position by two web straps and hoist, or other appropriate support.
(2) Locate engine and support to attach fittings and install four clevis bolts, washers, nuts and cotter keys.
(3) Uncap and connect fuel drain and gearbox vent lines at station 225 bulkhead.
(4) Uncap and connect fuel line at station 225 bulkhead.
(5) Connect the wires at start/dropout relay.
(6) Connect ground wires at station 225 bulkhead.
(7) Connect the electrical connections at station 225 bulkhead left side.
(8) Install the tailcone.

C. Alignment.

NOTE: When a replacement of the APU is effected, the exhaust should protrude through the nacelle tail cone skin a minimum of 1/4-inch (1/2-inch maximum) and should be approximately centered in the opening. If the fit is not satisfactory, adjust as follows, do not rework tail cone.

(1) Remove nacelle tail cone.
(2) Remove exhaust pipe from APU.
(3) Use a bubble protractor on aft face of nacelle bulkhead and on the outlet face of combustor housing to determine that vertical planes are within ± 1/2 degree of each other. Vertical adjustment can be obtained by equally adjusting length of bottom engine supports at the two forks, P/N 44751.
(4) Tighten jam nuts on forks against lower supports when the correct vertical adjustment is obtained.
(5) Install exhaust pipe.
(6) Install nacelle tail cone.

NOTE: If the exhaust is not approximately centered in the opening, ascertain that the exhaust pipe is installed properly, make minor adjustments to lower supports to obtain needed fit.

"END"

AIRBORNE AUXILIARY POWER - POWER PLANT

The APU is assembled as a complete unit, including the generators, generator control components, APU control relays and solenoids, and associated wiring. The entire unit is mounted to the right nacelle aft bulkhead with four attach fittings. Electrical connections to the ac generator and various control components are made through two connector plugs mounted on the bulkhead. Grounding lugs for the dc generator and three fuel line connections are mounted on the bulkhead.

The dc generator positive leads pass through the bulkhead using a clamp and sealing compound.

Access to the APU is gained by removing the nacelle tail cone. An access door on the outboard side of the tail cone allows limited inspection and servicing.

"END"

AIRBORNE AUXILIARY POWER - ENGINE

The turbine engine is of a single-shaft design in which the compressor and turbine rotors are mounted back-to-back on a common shaft. Power produced by the turbine is transmitted through the shaft to a reduction gear box with pads for the two generators. Fuel for the turbine is supplied from the right collector tank through a normally open manual shut-off valve, an electrically operated shut-off valve. A filter is provided in the fuel line in addition to those incorporated in the APU upstream of the APU fuel inlet. During the starting cycle, fuel from a single start nozzle is ignited by an igniter plug. After combustion begins, the start fuel nozzle and igniter are turned off. Burning continues with fuel flowing through six vaporizer tubes into the combustion section. Air for the compressor and cooling is supplied by louvres in the nacelle skin. Initial drive during the starting cycle is supplied electrically by converting the dc generator to a starter motor. As combustion begins to deliver power to the turbine shaft, electrical load sensing in the starter circuit reconverts the starter motor to a dc generator. Output of the generator is not available, however, until the turbine has reached 80% of normal running speed.

"END"

AIRBORNE AUXILIARY POWER - MAINTENANCE PRACTICES

1. REMOVAL AND INSTALLATION - APU.

A. Removal.

(1) Remove the right tail cone.
(2) Disconnect the electrical connections at station 225 bulkhead left side.
(3) Disconnect ground wires at station 225 bulkhead.
(4) Identify, label and disconnect wires from start/dropout relay.
(5) Disconnect and cap fuel line at station 225 bulkhead.
(6) Disconnect and cap fuel drain lines at station 225 bulkhead.
(7) Use two web straps and hoist, or other appropriate support for the APU.
(8) Remove cotter keys, nuts, washers, and four clevis bolts from attach fittings at station 225 bulkhead.
(9) Remove the APU.

B. Installation.

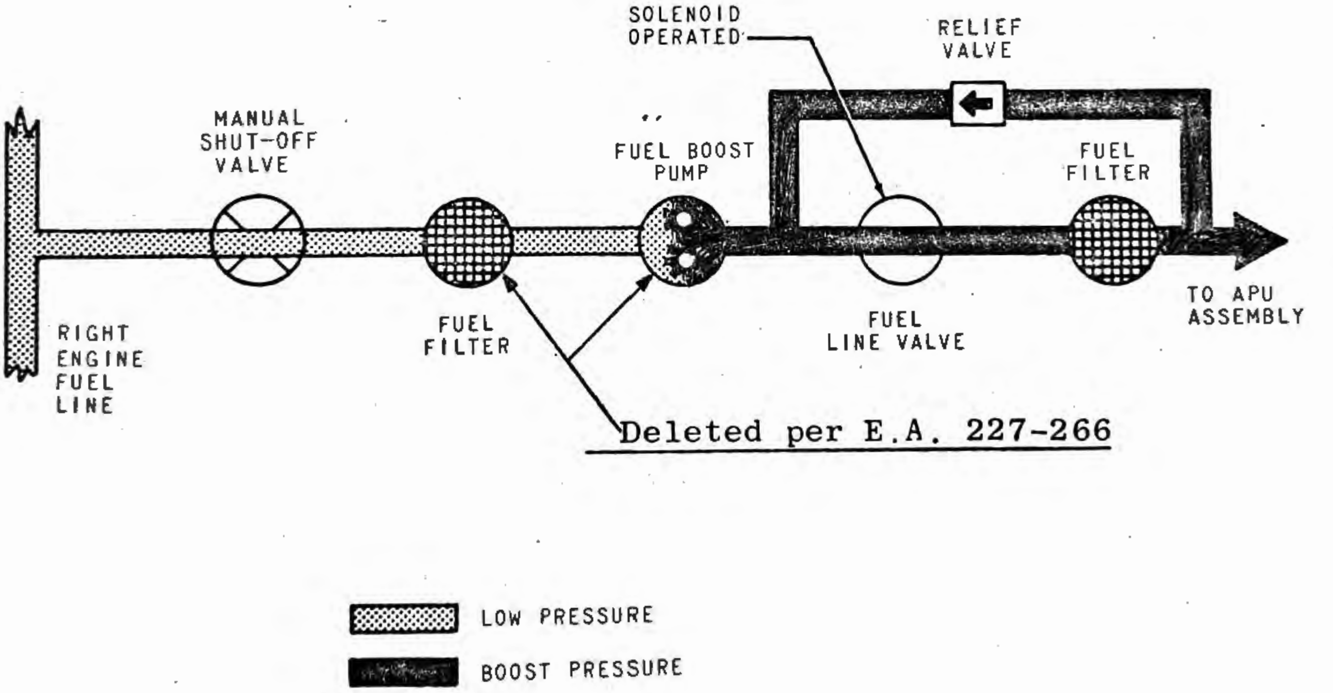
(1) Locate the APU into position by two web straps and hoist, or other appropriate support.
(2) Locate engine and support to attach fittings and install four clevis bolts, washers, nuts and cotter keys.
(3) Uncap and connect fuel drain lines at station 225 bulkhead.
(4) Uncap and connect fuel line at station 225 bulkhead.
(5) Connect the wires at start/dropout relay.
(6) Connect ground wires at station 225 bulkhead.
(7) Connect the electrical connections at station 225 bulkhead left side.
(8) Install the tailcone.

"END"

AIRBORNE AUXILIARY POWER - ENGINE FUEL AND CONTROL

Fuel for the APU gas-turbine engine is supplied from a connection to the right airplane engine fuel line in the right nacelle. The fuel is supplied to the APU engine through a system consisting of a manual shut-off valve, a fuel filter , and a solenoid valve. Fuel for the APU is the same as that supplied to the airplane engines. Further fuel control units within the APU condition the fuel prior to delivery of the fuel to the engine.

Operation of the fuel system is automatically controlled by a series of switches, relays, and solenoids that comprise a part of the automatically operated APU system. (See the Solar Maintenance Manual.)



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APU Fuel Schematic (Supply Line)
Figure 1

1. COMPONENTS.

A. Manual Shut-Off Valve (Supply Line).

A manual fuel shut-off valve is located at station 119 of the right nacelle, downstream of the connection to the airplane engine fuel line. The valve provides a means of manually shutting off fuel to the APU engine fuel system.

B. Fuel Filter (Supply Line).

A fuel filter is installed in the APU fuel system.

A filter is located at right nacelle station 152, provides filtering before the fuel is fed into the APU engine fuel control assembly.

C. Fuel Boost Pump (Supply Line). Deleted per E.A. 227-266

The fuel boost pump, located at right nacelle station 132, provides a constant pressure fuel supply to the APU engine. The pump motor operates from 28 volts dc.

D. Solenoid Valve (Supply Line).

A solenoid operated valve, located at right nacelle station 145, provides a means of electrically opening or closing the fuel line to the APU engine. The solenoid valve operates in conjunction with the fuel boost pump.

E. Relief Valve (Supply Line).

A relief valve is installed around the solenoid valve to relieve pressure in the fuel lines caused by thermal expansion.

F. Fuel Containment Enclosure.

The fuel containment enclosure is a metal container (base and cover) attached to the left output pad of the accessory drive assembly. The enclosure houses the fuel control assembly, the fuel pressure switch, and the start and main fuel solenoid valves. The fuel system components in the enclosure are interconnected with stainless steel tubing. Fittings and elbows for connection of the APU fuel system lines, the compressor pressure line, and drain lines are also incorporated.

G. Fuel Pump.

The fuel pump is a positive-displacement, gear-type pump. An outlet fuel pump filter, containing a wire-cloth element (10-micron filtration, nominal, 25 microns absolute), which may be removed for cleaning, is installed in the top of the pump housing. The fuel pump spline adapter fits into an eight-point square drive in the shaft portion of the accessory drive gear. The other end of the fuel pump drive shaft is splined-coupled to the governor drive head assembly in the governor. A drain port in the pump housing drains fuel that might leak past the pump drive seal, or past the pressure drop regulating valve pin. At 4130 rpm, the pump is capable of delivering 400 phr of fuel against a discharge pressure of 400 psig.

H. Fuel Pressure Switch.

The fuel pressure switch is installed in the fuel containment enclosure. The switch is a single-pole, double-throw switch rated for 7-ampere resistive, 3-ampere inductive load at 28 volts dc. The normally closed switch opens at 110 ± 10 psig on increasing pressure and closes on decreasing pressure above 70 psig.

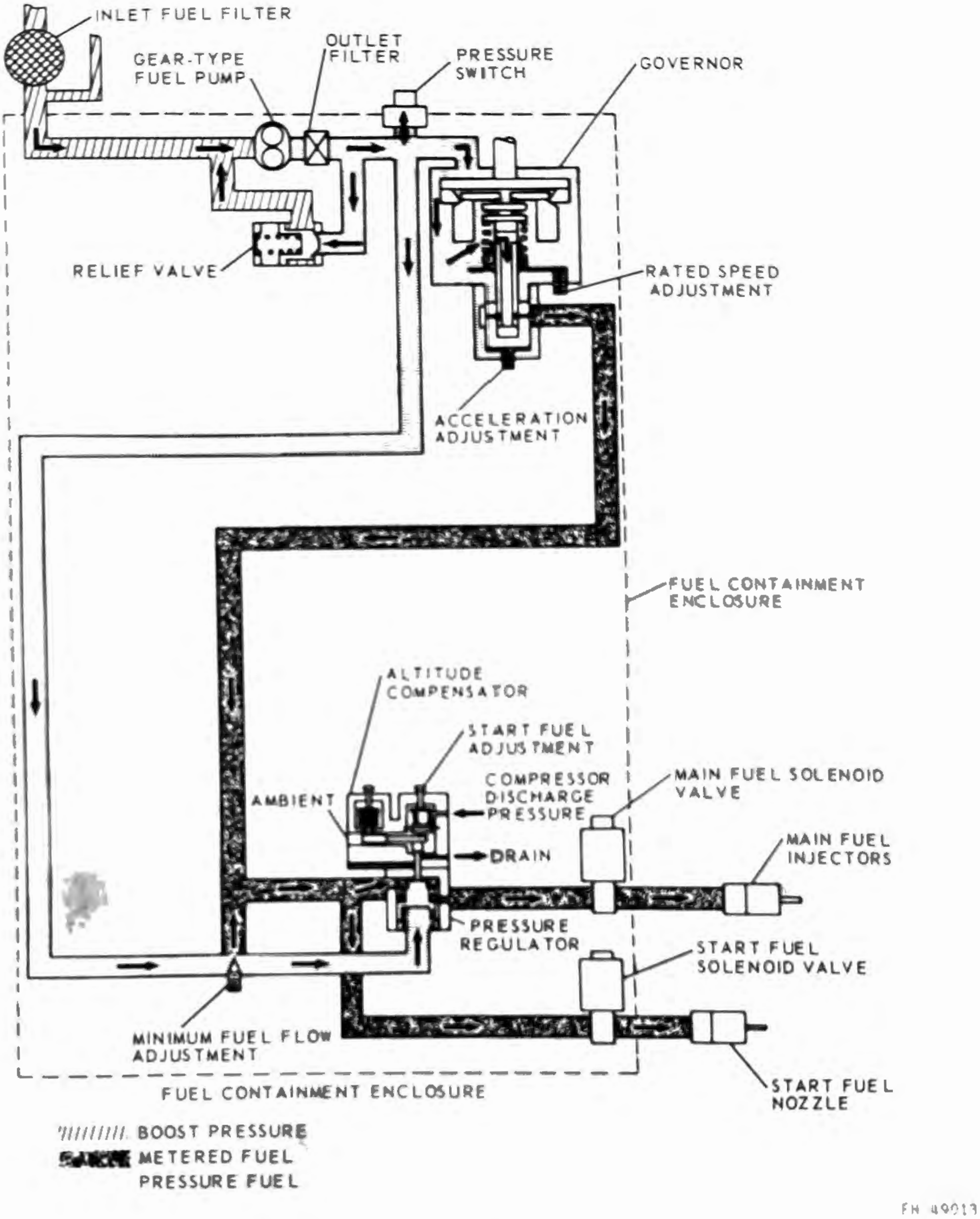
I. Governor.

Fuel flow to the main fuel injectors is controlled by the flyweight assembly, in the governor housing, to limit the speed of the engine. Increasing rotor speed above the set speed causes the free ends of the weights to pivot away from the axis of the governor drive head assembly. The pivoting action of the weights forces the weight tips against the bearing plate of the bearing and valve assembly, compressing the governor control spring, and moving the fuel metering valve in a direction to reduce fuel flow to the engine, thus preventing engine speed from exceeding rated speed.

Engine speed is controlled throughout the operating range. Adjustment is made by turning the rated speed adjusting screw in or out. This changes the position of the governor tension lever which increases or decreases the force at the governor control spring against the governor drive head assembly.

J. Main and Start Fuel Solenoid Valves.

The main and start fuel solenoid valves are installed in the fuel containment enclosure. The valves are operated by an electrical input of 18 to 28 volts dc, and are explosion-proof. The main fuel solenoid



APU Fuel System Schematic
Figure 2

valve is a normally closed valve, and is energized to the open position when the fuel pressure switch opens. The valve allows fuel to flow to the main fuel injectors. Deenergizing this valve causes a normal shutdown of the engine. The start fuel solenoid valve is a normally closed valve, and is also energized to the open position by the fuel pressure switch to supply fuel to the start nozzle. At 90 percent rated speed, the valve is deenergized by the rpm sensor. In the deenergized condition, the valve shuts off the fuel flow to the start fuel nozzle. Stainless steel tubing connects each valve with the fuel control assembly.

K. Start Fuel Nozzle.

The start fuel nozzle is located on the left side of the combustor. Fuel to the start fuel nozzle is controlled by the start fuel solenoid valve. Fuel sprayed by the start fuel nozzle is ignited by the spark plug, which is located in the combustor close to, and directly in line with, the start fuel nozzle. The start fuel nozzle is contained in a special fitting.

L. Main Fuel Injector Assembly.

Three main fuel injector assemblies are interconnected and equally spaced around the circumference of the combustor. Each injector incorporates an integral filter that provides filtration to 15 microns. Fuel is supplied to the main fuel injectors through the main fuel solenoid valve and the fuel manifold.

"END"

APU ENGINE FUEL AND CONTROL - MAINTENANCE PRACTICES

1. INSPECTION - APU ENGINE FUEL AND CONTROL LINES.

A. Inspect.

Inspect the APU fuel supply lines for fuel leakage at all disconnect points. Inspect electrical connectors for secure installation. Inspect fuel lines, fuel filter , and solenoid valve for security of mounting.

2. FUEL BOOST PUMP (SUPPLY LINE). Deleted per E.A. 227-266

A. Removal.

(1) Place manual fuel shut-off valve to closed.
(2) Disconnect the electrical connector from the boost pump.
(3) Disconnect the inlet and outlet fuel lines.
(4) Disconnect the pump seal drain line.
(5) Remove the four bolts and nuts which secure the boost pump to the mount bracket.

B. Installation.

(1) Secure the boost pump to the mounting bracket with the four bolts and nuts.
(2) Connect the pump seal drain line.
(3) Connect the inlet and outlet fuel lines.
(4) Install the electrical connector on the pump.
(5) Turn manual fuel valve to open and check for fuel leaks.

3. FUEL FILTER (SUPPLY LINE).

A. Filter Element Replacement.

(1) Close manual fuel shut-off valve.
(2) Remove lockwire securing case to head of fuel filter assembly.
(3) Turn lower case assembly counterclockwise and remove from head assembly.
(4) Discard gasket and used filter element and replace with new element and gasket.
(5) Reinstall lower case to head assembly and torque to 25 ± 5 pound-feet; install lockwire joining head and lower case assembly.
(6) Open manual fuel shut-off valve. Run the APU and inspect filter assembly for leaks.

B. Removal.

(1) Place manual fuel shut-off valve to closed.
(2) Disconnect and cap inlet and outlet fuel lines.
(3) Remove the bolts and nuts securing the fuel filter to the mounting assembly.

C. Installation.

(1) Mount the fuel filter with the outlet end on the downstream (APU end) of the fuel line.
(2) Connect fuel lines to filter.
(3) Place the manual fuel shut-off valve to open.

4. SOLENOID FUEL VALVE (SUPPLY LINE).

A. Removal.

(1) Turn manual fuel shut-off valve to closed.
(2) Disconnect electrical connector.
(3) Disconnect inlet and outlet fuel lines.
(4) Remove the two bolts and nuts securing the valve.

B. Installation.

(1) Secure fuel valve with two bolts and nuts.
(2) Connect the inlet and outlet fuel lines.
(3) Install the electrical connector.
(4) Turn manual fuel shut-off valve to open and inspect for leaks.

5. APU FUEL PUMP FILTER ELEMENT.

A. Removal and Inspection.

(1) Remove cap screws, washers, and fuel containment enclosure cover.
(2) Remove filter element retainer from fuel pump. Remove and discard gasket.
(3) Lift valve seat from fuel pump.
(4) Remove spring; then pull element from valve seat. Remove and discard O-ring.
(5) Clean and inspect.

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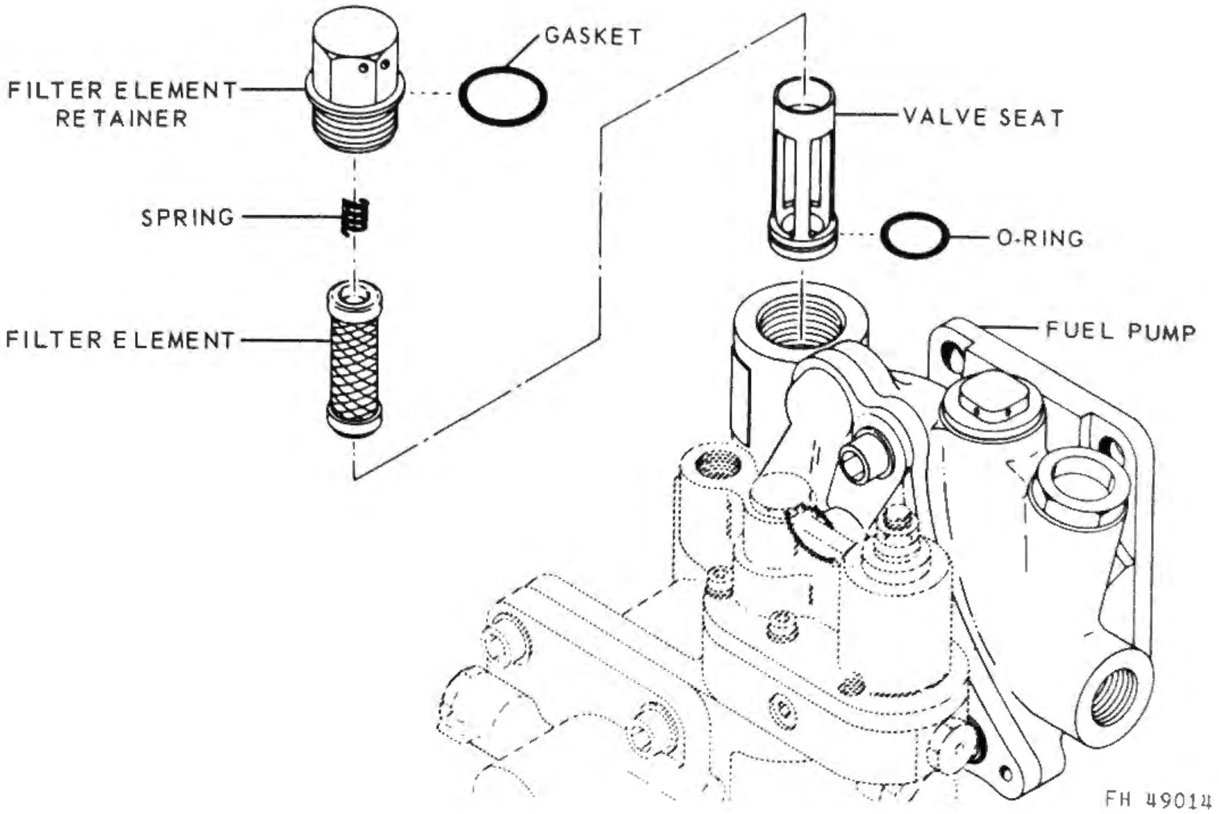


Fuel Pump Filter Disassembly
Figure 3

B. Installation.

(1) Installation of fuel pump filter element is reverse of removal. Install new O-ring and new gasket.
(2) Follow normal starting procedures to start engine. Start and operate engine for at least five minutes. Check for fuel leaks in fuel containment enclosure with engine operating.
(3) Replace fuel containment enclosure cover assembly.

6. APU FUEL PRESSURE SWITCH.

A. Removal and Inspection.

(1) Remove cap screws, washers, and fuel containment cover.
(2) Disconnect electrical connection from fuel pressure switch.
(3) Disconnect fuel line assembly from union on acceleration control assembly and fuel pressure switch.
(4) Remove nut, washer, rubber washer, and fuel pressure switch from fuel containment enclosure. Discard rubber washer.
(5) Visually check condition of fuel pressure switch. Functionally check switch if its operation is suspected of being faulty.

B. Installation.

(1) Installation of fuel pressure switch is reverse of removal. Install new rubber washer on assembly.
(2) Follow normal starting procedures to start engine. Start and operate engine for at least five minutes. Check for fuel leaks in fuel containment enclosure with engine operating.
(3) Replace fuel containment enclosure cover.

7. APU FUEL SOLENOID VALVES.

A. Removal.

NOTE: Prior to removal of the start and main fuel solenoid valves, tag each valve and its respective electrical harness connector to facilitate valve reinstallation.

(1) Remove cap screws, washers, and fuel containment cover.
(2) Disconnect electrical connection from fuel solenoid valve to be removed.
(3) Disconnect fuel line assembly from union on start fuel solenoid valve and union on acceleration control assembly.
(4) Disconnect fuel line assembly from universal elbow on start fuel solenoid valve and bulkhead union on fuel containment enclosure.
(5) Disconnect fuel line assembly from union on main fuel solenoid valve, and union on acceleration control assembly.
(6) Disconnect fuel line assembly from universal elbow on main fuel solenoid valve and bulkhead elbow on fuel containment enclosure.
(7) Place protective covers on disconnected components.
(8) Remove lockwire, screws, and washers from fuel solenoid valve. Remove solenoid valve from fuel containment enclosure.
(9) Remove union, O-ring, universal bolt, universal elbow, and banjo seal from fuel solenoid valve. Discard banjo seal and O-ring.

B. Inspection.

Inspect condition of threads. Inspect valve body for dents, cracks, and other visible damage. Replace valves if damaged or defective. Functionally check solenoid if its operation is suspected of being faulty.

C. Installation.

(1) Install new banjo seal and O-ring. Install universal elbow, universal bolt and union to fuel solenoid valve.
(2) Place solenoid valve in fuel containment enclosure and secure with washers and screws; safety with lockwire.

(3) Remove protective covers from disconnected components.
(4) Connect fuel line assembly to universal elbow on main fuel solenoid valve and bulkhead elbow to fuel containment enclosure.
(5) Connect fuel line assembly to union on main fuel solenoid valve and to union on acceleration control assembly.
(6) Connect fuel line assembly to universal elbow on start fuel solenoid valve and to bulkhead union on fuel containment enclosure.
(7) Connect electrical leads to solenoid valve.
(8) Follow normal starting procedures to start engine. Start and operate engine for at least five minutes. Check for fuel leaks in fuel containment enclosure with engine operating.
(9) Replace fuel containment enclosure cover.

8. FUEL DRAIN VALVE ASSEMBLY.

A. Removal and Inspection.

(1) Disconnect drain line connected to fuel drain valve assembly.
(2) Loosen jam nut securing drain valve to mounting boss, and remove fuel drain valve.
(3) Remove and discard O-ring.
(4) Inspect for thread condition and other visible damage.
(5) Connect a source of air with a 3/8-inch diameter supply line, and apply 15 psig air pressure to bulkhead end of valve; ball valve must seat at 2 to 11 psig and prevent air flow.
(6) Pour Stoddard solvent, or equivalent, into bulkhead end of valve; solvent must flow freely. Repair or replace valve damaged or defective.

B. Installation.

(1) Install new O-ring.
(2) Position fuel drain valve on mounting boss and secure with jam nut.
(3) Connect drain line to fuel drain valve assembly.

9. ENGINE RATED SPEED SETTING - ADJUSTMENT.

A. Remove capscrews, washers, and fuel containment cover from fuel containment enclosure.

B. To adjust engine rated speed, insert a 3/32-inch hex-type wrench in rated speed adjusting setscrew. Loosen locknut and turn setscrew in required direction.

NOTE: Clockwise rotation increases speed and counterclockwise rotation decreases speed. Rotating setscrew 90 degrees gives approximately 65 rpm increase or decrease.

C. Perform final adjustment and tighten locknut with engine running.

D. After final adjustment, check and readjust acceleration schedule if necessary.

10. ACCELERATION SCHEDULE - ADJUSTMENT.

CAUTION: THE ACCELERATION SCHEDULE SETSCREW CAN EASILY BE DAMAGED BY OVERTIGHTENING THE LOCKNUT. TIGHTEN THE LOCKNUT 1/8-TURN BEYOND FINGERTIGHT.

A. To adjust acceleration schedule, insert 3/32-inch hex-type wrench in setscrew. Loosen locknut and turn setscrew in required direction.

NOTE: Clockwise rotation increases acceleration schedule fuel flow; counterclockwise rotation decreases it. Adjustment is critical and the initial position should be noted carefully.

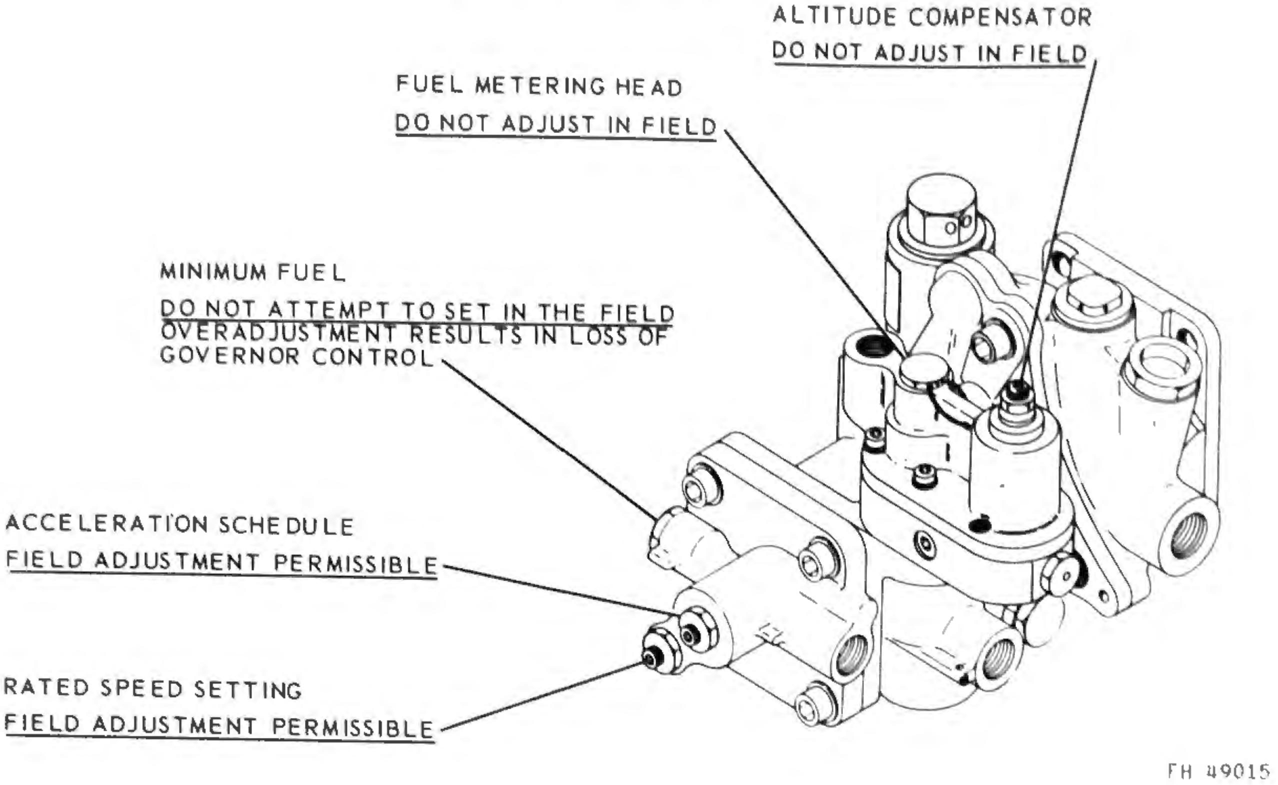
B. Increase acceleration schedule if turbine hesitates during acceleration. Decrease acceleration schedule if turbine rumbles (indication of a hot start) or EGT is above 1040°F during acceleration.

C. Make adjustments in small increments.

D. Make minimum of two engine starts between adjustments. Disregard characteristics of first start after adjustment.

E. After final adjustment, check and readjust rated speed setting if necessary.

F. Install fuel containment cover on enclosure, and secure with washers and capscrews.



Acceleration Control Assembly Adjustment
Figure 4

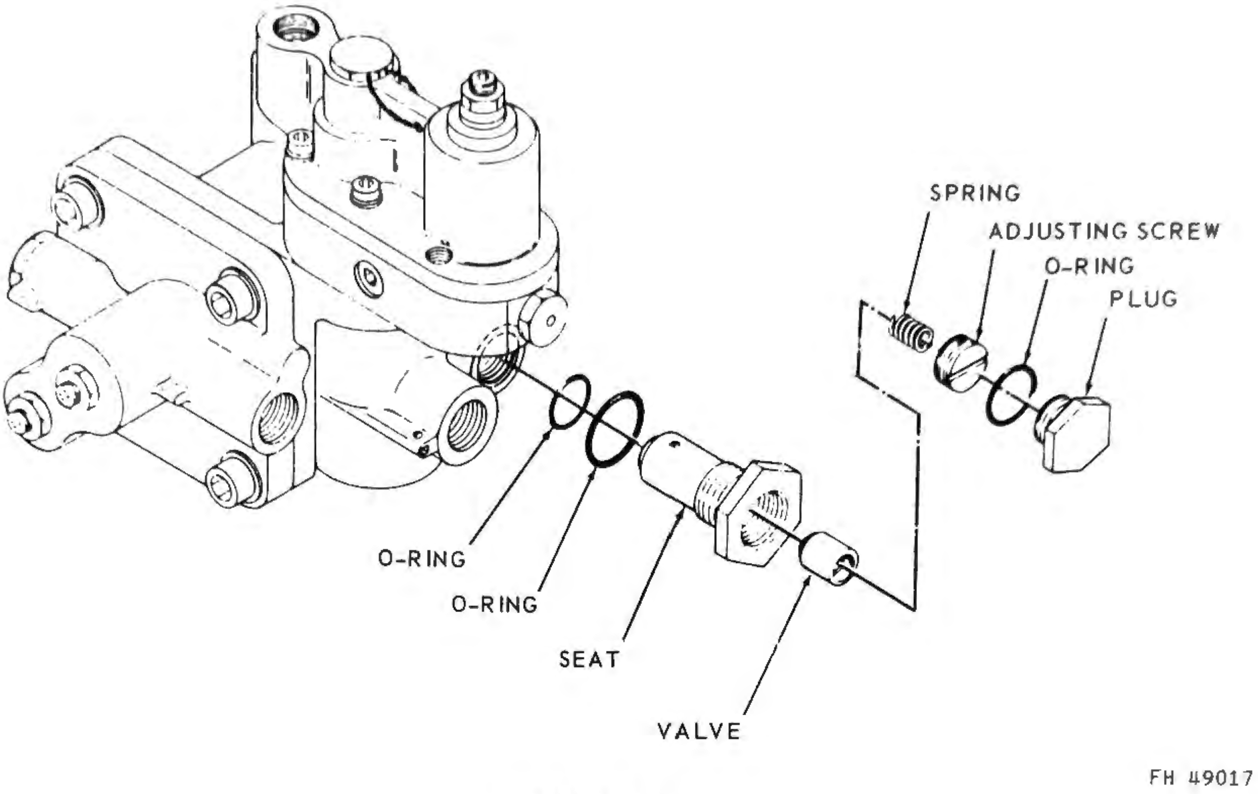
11. CLEAN/INSPECT/ADJUST - PRESSURE RELIEF VALVE.

A. Cleaning. (See Figure 5.)

(1) Shut down APU and boost pump.
(2) Remove plug and O-ring after removing lockwire.
(3) Remove valve seat; valve, spring, and adjusting screw remain installed. Remove and discard O-rings.
(4) Match-mark adjusting screw to outside face of seat to facilitate a return to existing adjustment for reassembly; remove the adjusting screw and carefully record the number of turns required to remove.
(5) Remove spring and valve.
(6) Thoroughly clean parts with solvent and bristle brush.

B. Inspect.

(1) Inspect valve and valve seat; any noticeable imperfections in either the valve or the seat is cause for rejection.



Relief Valve
Figure 5

C. Adjustment.

(1) Hold seat in a vertical position and install valve, spring and adjusting screw; adjust screw to same number of turns recorded in step (4) and align match marks.

CAUTION: TO ENSURE THAT VALVE DOES NOT BECOME TILTED ON ITS SEAT DURING ASSEMBLY, PARTS MUST BE INSTALLED WITH SEAT IN A VERTICAL POSITION (HEXAGON END UP).

(2) Install new O-ring (MS29512-4) on plug and install plug in seat.

(3) Install new O-rings (MS29512-6 and MS29513-12), install seat and valve assembly in acceleration control.

(4) Locate tube connecting fuel pressure switch to acceleration control assembly; disconnect at fuel pressure switch and loosen at acceleration control. Swing tube to a position that will enable the attachment of a 0 to 500 psi pressure gage to the open end. Tighten both tube connections.

CAUTION: DO NOT OPERATE OR CRANK ENGINE WITH PLUG REMOVED.

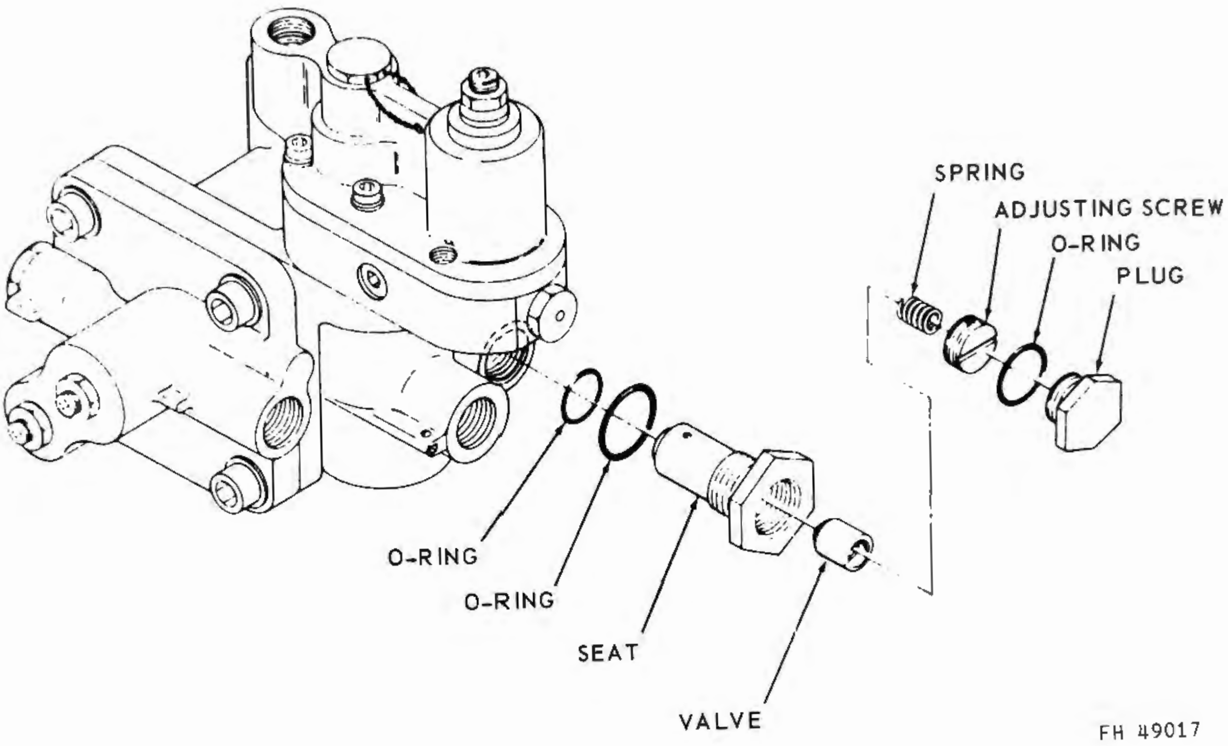
(5) Turn fuel boost pump on; crank APU and observe pressure gage.

NOTE: No fuel injection or ignition spark will occur at combustor because fuel pressure switch is not sensing pressure.

(6) When APU reaches maximum crank speed the gage should indicate between 360 and 385 psig at a minimum of 20 percent rated speed.
(7) If pressure exceeds 385 psig stop cranking and allow engine to come to a stop; remove plug and turn adjusting screw counterclockwise.
(8) If pressure was below 360 psig, turn adjusting screw clockwise. Reinstall plug before rechecking pressure.

NOTE: If pressure is still low after full adjustment of relief valve the most logical causes are: improper assembled or defective relief valve, no boost pressure, or defective fuel pump.

"END"



Relief Valve
Figure 5

"END"

AIRBORNE AUXILIARY POWER - ELECTRICAL SYSTEM

1. GENERAL.

The engine mounted components of the electrical system are an ac generator, dc starter-generator, ignition exciter, spark plug, RPM sensor, tachometer generator, hour meter, dc voltmeter circuit breaker, and overheat detectors. Descriptions of the oil pressure switch, fuel pressure switch, and fuel solenoid valves, which are engine mounted, are given in the description of the fuel and oil systems. Other electrical system components such as current transformers, voltage regulators, generator control panels and resistors are installed on the electrical panels fitted to the engine support frame. Control switches, indicating lights, meters, and a warning horn are installed on the cockpit control panel.

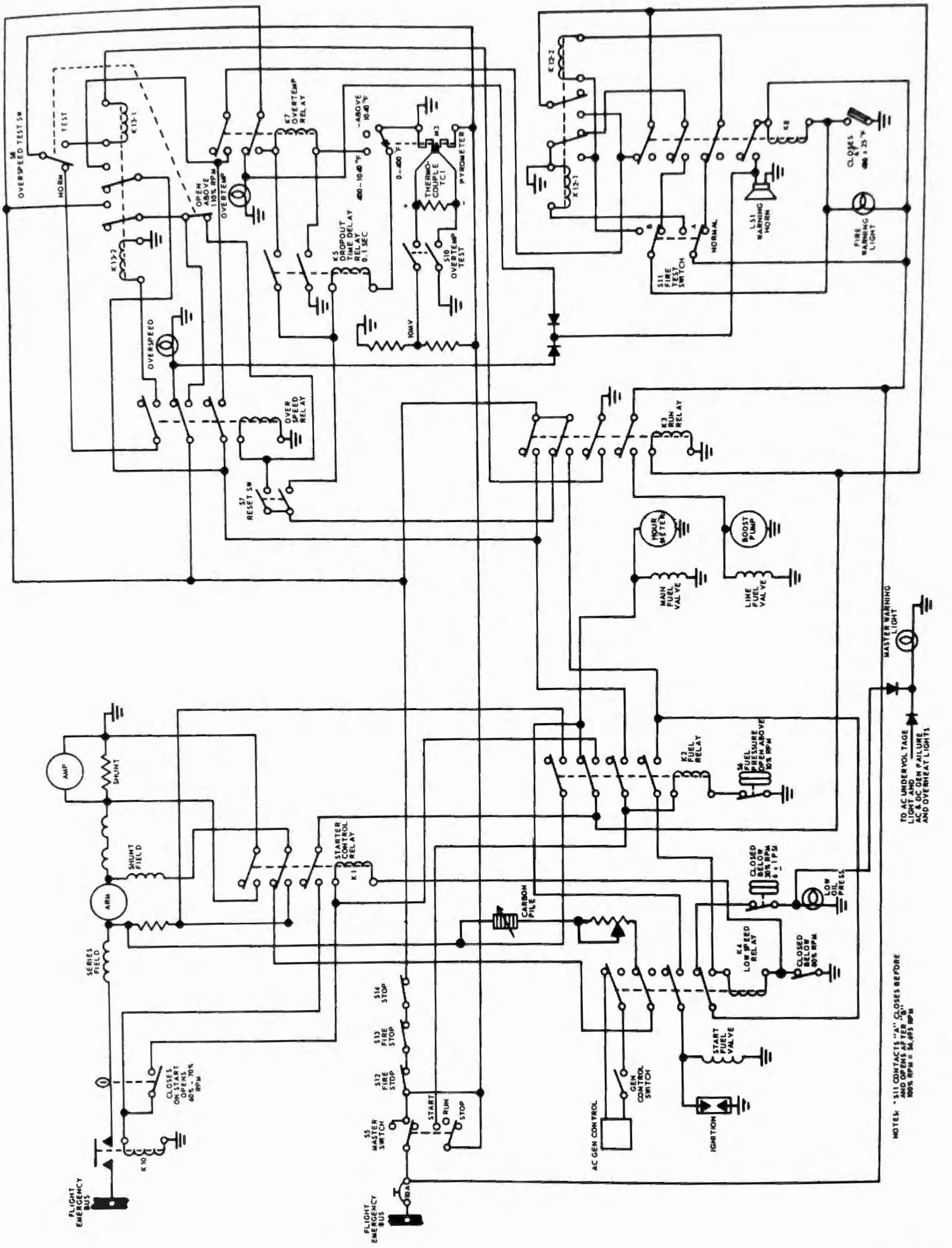
2. COMPONENTS.

A. Ignition Exciter.

The ignition exciter, bolted to the turbine assembly, is a capacitor-discharge type that converts the direct current input into a high energy alternating current which is then supplied to the spark plug for fuel ignition. The minimum spark rate is two sparks per second at 14 volts dc input. The output lead and spark plug connector are an integral part of the ignition exciter assembly.

B. Spark Plug.

A 10 millimeter, shunted-surface, gap type spark plug is threaded into a boss in the lower aft section of the combustor scroll, and provides the spark necessary for initial ignition of fuel during the starting phase of engine operation.



NOTES: * S11 CONTACTS "A" CLOSES BEFORE AND OPENS AFTER "B"
100% RPM = 56,695 RPM

FH 49012

APU Electrical Control Schematic
Figure 1
"END"

APU ELECTRICAL SYSTEM - MAINTENANCE PRACTICES

1. IGNITION EXCITER.

A. Removal.

(1) Disconnect and insulate ignition exciter input lead.
(2) Disconnect ignition exciter cable (integral part of ignition exciter) from spark plug.
(3) Remove nut, washer, screw, and cushioned clamp from clamp support bracket.
(4) Remove nut, washer, and capscrews attaching ignition exciter to exciter mounting bracket.
(5) Remove capscrew and washer attaching exciter mounting bracket to air inlet housing.

B. Inspection.

(1) Inspect ignition exciter for visible damage.
(2) Inspect exciter cable for security of attachment to exciter and for damage.
(3) Replace ignition exciter if damaged, if metal braid on cable is damaged, or if cable at exciter is loose.

C. Installation.

(1) Attach exciter mounting bracket to air inlet housing with a washer and a capscrew.
(2) Attach ignition exciter to exciter mounting bracket with a capscrew, washer and nut.
(3) Install cushioned clamp support bracket with a screw, nut and washer.
(4) Connect ignition exciter cable (integral part of ignition exciter) to spark plug.
(5) Remove insulation from exciter input lead and install.

2. SPARK PLUG.

A. Removal, Inspection, and Installation.

(1) Disconnect and insulate ignition exciter input lead.
(2) Disconnect ignition exciter cable (integral part of ignition exciter) from spark plug.

(3) Remove spark plug from boss; remove and discard gasket.
(4) Inspect for cracked or eroded insulator, and eroded or corroded electrode.
(5) Remove carbon from spark plug with a dry, fiber brush.
(6) Installation is reverse of removal; install new gasket. Lockwire spark plug with wire, MS20995C32.

"END"

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SEE REVERSE SIDE.

TITLE: AIRBORNE AUXILIARY POWER - AIR

FILING: Insert this sheet facing page 1, chapter 49-50-0 (dated Sept. 15-68, X-9). Do not remove any manual pages as a result of this supplement.

REFERENCE: E.A. 227-149.

REASON: This supplement is issued to reflect the addition of an air inlet screen on the APU.

In paragraph 1, "COMPONENTS," change item "A" to read as follows:

1. COMPONENTS.

A. Air Inlet Duct Assembly.

The air inlet duct assembly is an aluminum shroud that forms a plenum around the air inlet portion of the turbine assembly housing. The air inlet duct is fabricated in two sections bolted together around the air inlet. On Piedmont airplanes, an air inlet screen is installed at the air inlet duct opening to prevent the entry of foreign objects into the auxiliary power unit.

"END"

AIRBORNE AUXILIARY POWER - AIR

Air for combustion and cooling is supplied through a louvered opening in the nacelle tail cone. No ducting is installed.

1. COMPONENTS.

A. Air Inlet Duct Assembly.

The air inlet duct assembly is an aluminum shroud that forms a plenum around the air inlet portion of the turbine assembly housing. The air inlet duct is fabricated in two sections which are bolted together around the air inlet. On airplanes incorporating SB 49-13, a screen is incorporated in the air inlet duct to prevent entry of foreign objects.

"END"

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SEE REVERSE SIDE.

TITLE: APU AIR - MAINTENANCE PRACTICES

FILING: Insert this sheet facing page 201, chapter 49-50-0 (dated Sept. 15-68, X-9). Do not remove any manual pages as a result of this supplement.

REFERENCE: E.A. 227-149.

REASON: This supplement is issued to show additional removal/installation steps involved in the APU air inlet assembly because of the addition of an inlet screen.

In paragraph 1, "AIR INLET DUCT ASSEMBLY," change item "A" step (4) to read:

A. Removal and Inspection.

(4) Remove nuts and washers securing two air inlet duct halves together. Separate air inlet duct halves and remove from turbine air inlet housing. Remove safety wire from air inlet screen and withdraw screen.

Change item "B", step (1) to read:

B. Installation.

(1) Reinstall air inlet screen, securing each end with .041 stainless steel safety wire. Assure that no safety wire enters the inlet into the APU.

"END"

APU AIR - MAINTENANCE PRACTICES

1. AIR INLET DUCT ASSEMBLY.

A. Removal and Inspection.

(1) Disconnect electrical leads from hour meter and from dc voltmeter and from dc voltmeter circuit breaker.
(2) Remove capscrews and washers securing hour meter mounting bracket to air inlet duct assembly.
(3) Remove hour meter and mounting bracket from air inlet duct assembly.
(4) Remove nuts and washers securing two air inlet duct halves together. Separate air inlet duct halves and remove from turbine air inlet housing. Remove air inlet screen (SB 49-13), if installed.
(5) Inspect duct assembly for cracks, particularly in welded areas. Replace duct assembly if cracked or damaged.

B. Installation.

(1) Reinstall air inlet screen (SB 49-13), if available.
(2) Place two air inlet ducts halves together on turbine air inlet housing; secure with washers and nuts.
(3) Install hourmeter mounting bracket and hour meter to air inlet duct assembly with washers and capscrews.
(4) Connect electrical leads to hour meter, to dc voltmeter, and to dc voltmeter circuit breaker.

"END"

AIRBORNE AUXILIARY POWER - ENGINE CONTROLS

1. COMPONENTS.

A. APU Start Switch.

The APU electrical system is designed to sequence through the required starting steps automatically. To operate the APU, the switch is moved from the OFF position to the ON position. The reset switch is then held momentarily to the RESET position, after which the start switch is positioned to START and then to RUN (same switch position as ON). To shut down the APU, the start switch is positioned to STOP (same switch position as OFF). Restarting of the APU cannot be accomplished unless the turbine temperature is below 400° F.

B. APU Reset Switch.

The reset switch on the APU control panel is used in conjunction with the start switch to operate the APU. After the start switch is placed to ON, the reset switch is positioned momentarily to RESET and then allowed to return to the spring-loaded NORMAL position before continuing the starting sequence using the APU start switch.

C. Turbine Stop Switch.

A guarded spring-loaded switch on the refueling panel in the aft right nacelle is provided to permit ground personnel to shut down the APU.

"END"

AIRBORNE AUXILIARY POWER - INDICATING

1. INDICATORS.

A. APU Warning Horn.

A warning horn incorporated in the APU control panel will sound in response to fire in the APU compartment or overspeed or overheating of the APU. A warning light on the APU control panel simultaneously illuminates to indicate which malfunction has occurred. The APU is automatically shut down whenever any of these malfunctions is indicated.

B. Turbine Temperature Indication, Warning And Test.

A chromel-alumel thermocouple mounted in the turbine exhaust stream senses temperature for display on the APU control panel and for automatic shutdown of the APU in event of overtemperature or flame-out. Either of the malfunctions shuts down the APU by shutting off fuel to the turbine. At the same time a red overtemp indicator light on the APU control panel illuminates and the APU warning horn sounds. The light will remain illuminated and the horn will continue to sound even after an overtemp condition has passed until the RESET switch is operated. A ten second waiting period should be observed before attempting a restart, to permit drainage of excess fuel from the combustion section. Temperature should not exceed 1025°F for more than 10 seconds and in no case exceed 1040°F. A test circuit permits checkout of the temperature warning circuitry.

NOTE: The test switch for the temperature warning circuit must be used only while the APU is not operating.

C. Turbine RPM Indication, Warning And Test.

A tachometer generator mounted on the gear box supplies information to a tachometer indicator, calibrated in percent rpm, located on the APU control panel, and supplies information for overspeed shut-down of the APU. At 110% of normal turbine speed the overspeed indicator light illuminates, the APU warning horn sounds and the APU is automatically shut down. Actuating the reset switch returns the system to normal. An overspeed shutdown indicates mechanical failure; therefore, restart should not be attempted until the cause of the overspeed has been investigated. A test circuit permits checkout of the overspeed circuitry to ascertain that the system is armed.

NOTE: The TEST switch for the overspeed circuit must be used only when the APU is running at normal speed.

D. RPM Sensor.

The rpm sensor is a speed sensing device that monitors certain engine functions and shuts down the engine if an overspeed condition occurs. The input signal for the rpm sensor is received from the tachometer generator.

The sensor incorporates solid state circuits and two single-pole, double-throw output relays. One relay is an 80% speed switch; the other is a 110% speed switch. The output of each relay is adjustable over a reasonable speed range. Adjusting screws No. 1 and No. 2, on the sensor, adjust the 80% speed switch and the 110% speed switch, respectively. Clockwise rotation of the screw increases the percent setting at which the switch contacts actuate, counterclockwise rotation decreases it. Screw No. 3 is for the rpm meter calibration.

External screw terminals on the sensor provide connections for the tachometer generator signal (input to sensor), the rpm meter signal (output from sensor), and the overspeed test switch on the cockpit control panel.

E. Overheat Or Fire Indicators.

Three adjustable overheat detectors are located on the engine to warn of a fire, or overheat condition, in the engine nacelle. When the temperature reaches 400 ± 25°F in the engine nacelle, the overheat detector contact closes, completing an electrical circuit which illuminates a red fire warning light on the flight compartment control panel, illuminates a red fire warning light on the nacelle panel, sounds a warning horn, and automatically shuts down the APU. Refer also to FIRE PROTECTION, Chapter 26.

One overheat detector and mounting bracket is installed beneath the air inlet housing. The mounting bracket is held in place by the lower engine support (V-frame) attaching bolt. One overheat detector and mounting bracket is installed on top of the reduction drive assembly housing; the third overheat detector is mounted on the hourmeter bracket located on the air inlet muff.

F. APU Master Warning Light.

A yellow warning light on the copilot's instrument panel illuminates simultaneously with the APU turbine low oil pressure indicator light or any APU generator indicator light on the APU control panel. The light on the instrument panel, provides an indication directly in both pilots' fields of vision. The pilot should then refer to the APU control panel and see which light is illuminated to ascertain the specific malfunction. Appropriate corrective action may then be taken.

G. Turbine Low Oil Pressure Warning.

The APU oil system is self-contained and includes a pressure-actuated switch that illuminates a red low oil pressure light on the APU control panel and the APU master warning light on the copilot's instrument panel when oil pressure drops below the required operating pressure.

H. Hour Meter.

The hour meter is mounted on the air inlet duct on the left side of the engine. This unit indicates the total accumulated engine operating hours.

I. APU-driven AC Generator Indicators.

Indicator lights for generator overheat, undervoltage, and generator failure, and a dual range, phase-switchable ammeter are mounted on the APU panel. Refer to AC GENERATION, Chapter 24-20-0.

J. APU-driven DC Generator Indicators.

Indicator lights for generator overheat and generator failure, and a dc ammeter are mounted on the APU control panel. Generator voltage can be read on the dc voltmeter located on the right overhead panel. Refer to DC GENERATION, Chapter 24-30-0.

"END"

APU INDICATING - MAINTENANCE PRACTICES

1. THERMOCOUPLE.

A. Removal and Inspection.

(1) Remove nuts attaching wire terminals to thermocouple and remove wire terminals; reinstall nuts on thermocouple terminals to prevent loss.
(2) Remove exhaust duct blanket assembly. Refer to paragraph EXHAUST DUCT BLANKET ASSEMBLY for removal procedure.
(3) Remove thermocouple by unscrewing swivel nut on thermocouple from boss on exhaust end of combustor.
(4) Inspect for thread condition and other visible damage; replace thermocouple if damaged.

B. Installation.

(1) Install thermocouple by screwing swivel nut on thermocouple to boss on exhaust end of combustor.
(2) Install exhaust duct blanket assembly. Refer to paragraph EXHAUST DUCT BLANKET ASSEMBLY for installation procedure.
(3) Remove nuts on thermocouple terminals; using nuts just removed, attach wire terminals to thermocouple.
(4) Lockwire thermocouple with wire, MS20995C32.

2. TACHOMETER GENERATOR.

A. Removal and Inspection.

(1) Disconnect electrical harness connector from tachometer generator.
(2) Remove nuts and washers attaching tachometer generator to accessory drive output pad. Remove tachometer generator.
(3) Remove and discard gasket.
(4) Inspect condition of threads. Inspect for dents, cracks in mounting flange, and other visible damage.
(5) Replace tachometer generator if electrical connection is damaged or if mounting flange is cracked.
(6) Check drive shaft for cracks and freedom of rotation.

B. Installation.

(1) Install new gasket on generator.
(2) Place tachometer generator on accessory drive output pad and secure with washers and nuts.
(3) Connect electrical harness connector to tachometer generator.

3. RPM SENSOR - ADJUSTMENT.

The rpm sensor is adjusted by connecting one lead of a frequency meter to terminal T1, T2, or T3, below the ac generator, and the other lead to ground. The engine is started and the rated speed setting is adjusted (on the acceleration control) until the frequency meter reads 440 cycles. Screw No. 2 on the rpm sensor is then turned slowly in a clockwise direction to obtain an engine shutdown; clockwise rotation increases percent setting. When the engine shuts down, with the meter reading 440 cycles, the 110 percent adjustment on the rpm sensor is established. The rated speed setting adjusting screw must then be turned counterclockwise to prevent an overspeed shutdown on start. The engine must be restarted and rated speed setting on the acceleration control adjusted until the meter reads 400 cycles; then the adjusting screw is locked. Screw No. 3 is then turned slowly (on the rpm sensor) in the proper direction to obtain 100 percent indication on the rpm meter; clockwise rotation increases percent setting.

4. HOUR METER.

A. Removal.

(1) Disconnect electrical leads from hour meter.
(2) Remove nuts, washers, and screws securing hour meter to mounting bracket. Remove hour meter from mounting bracket.
(3) If hour meter and mounting bracket are to be removed as a single unit, disconnect electrical leads from dc voltmeter circuit breaker, and remove capscrews and washers securing hour meter mounting bracket to air inlet duct assembly; then remove assembly.

B. Inspection.

(1) Inspect glass on hour meter for cracks, nicks, and scratches.
(2) Inspect hour meter body for dents and other visible damage.
(3) Replace hour meter if glass is cracked, or if hour meter is not operating.

C. Installation.

(1) Install hourmeter mounting bracket to air inlet duct assembly with washers and capscrews.
(2) Install hourmeter to mounting bracket with screws, washers and nuts.
(3) Connect electrical leads to hourmeter.

5. OVERHEAT DETECTOR.

A. Removal and Inspection.

(1) Remove electrical harness terminals from overheat detector.
(2) Remove nut, washer, and capscrew from overheat detector; remove overheat detector from bracket.
(3) Inspect overheat detector for damage; replace if damaged.

B. Installation.

(1) Install overheat detector to overheat detector bracket with capscrew, washer and nut.
(2) Connect electrical harness to overheat detector electrical terminals.

"END"

AIRBORNE AUXILIARY POWER - EXHAUST

1. EXHAUST DUCT ASSEMBLY.

The exhaust duct assembly is clamped to a flange on the exhaust end of the combustor assembly. The duct assembly is positioned to direct the engine exhaust gases overboard through the aft end of the aircraft engine nacelle cone. A heat blanket is installed over the exhaust duct for protective measures.

2. EXHAUST DUCT BLANKET ASSEMBLY.

The exhaust duct blanket assembly is composed of insulation material enclosed in a high-temperature corrosion-resistant metal foil envelope. The blanket assembly is fabricated in two sections that are laced together at their mating edges. Both inner and outer foil skins are double-corrugated for maximum rigidity. The blanket assembly is installed over the exhaust duct.

"END"

APU EXHAUST - MAINTENANCE PRACTICES

1. EXHAUST DUCT ASSEMBLY.

A. Removal and Inspection.

(1) Remove exhaust duct blanket assembly.
(2) Remove clamp attaching duct assembly to flange on exhaust end of combustor housing. Remove duct assembly.
(3) Inspect duct assembly for burns and warpage. Burns or warped flange is cause for replacement.

B. Installation.

(1) Place exhaust duct assembly on flange on exhaust end of combustor housing and secure with clamp.
(2) Install duct blanket assembly.

2. EXHAUST DUCT BLANKET ASSEMBLY.

A. Removal and Inspection.

(1) Remove lacing wire connecting two blanket halves together, and carefully remove each blanket half from exhaust duct, taking care not to tear blanket material.
(2) Inspect blanket halves for tears and cracks on internal and external surfaces. Broken metal skin is cause for replacement. Minor dents, scratches, and surface corrosion is acceptable.

B. Installation.

(1) Place the two blanket halves together on exhaust duct, taking care not to tear blanket material.
(2) Using new lacing wire, MS20995C32, lace the two blanket halves together.

CAUTION: OVERLAP THE BLANKET HALVES BENEATH THE TERMINAL END OF THE THERMOCOUPLE TO PREVENT FUEL FROM COMING IN CONTACT WITH HOT SURFACES OF THE EXHAUST DUCT.

"END"

AIRBORNE AUXILIARY POWER - OIL

1. GENERAL.

The lubrication system provides lubrication to the high-speed input pinion, reduction and accessory gears, and bearings. The lubrication system consists of the oil pump, oil filter, pressure relief valve, filter bypass relief valve, oil pressure switch, oil jet ring, centrifugal oil separator plates, oil passages, and oil pan (sump). The engine will operate satisfactorily on any of the approved oils; however, one type of oil should not be mixed with any other type of oil.

2. LUBRICATION SYSTEM FUNCTION.

The pump draws oil out of the sump and into the pump housing. From the pump, oil is forced through drilled passages to the filter. Oil enters the filter housing, passes through the element (from outside to inside) and flows out of the housing through a passage in the filter element cap.

In the filter element cap a relief valve unseats at 15 to 25 psig pressure and allows oil to flow from outside the element, through a passage in the element cap to the filter outlet passage so that if the filter element becomes clogged, oil will bypass the element.

From the filter, oil if forced into a passage to the system relief valve and three oil jets. The three jets, in the oil jet ring, direct oil spray to the points where the high-speed input pinion meshes with the three planetary gears and input pinion. Another oil jet directs oil to the meshing point of the Zerol bevel gears.

The air-oil mist for rotor shaft bearing lubrication is supplied through an oil jet adjacent to the oil jet ring. This jet directs oil spray to the aft end of the Zerol bevel gear shaft, then, is directed through the hole in the center of the input pinion, and flows aft through the hollow input pinion. A dam (raised area) diverts a portion of this mist, and centrifugal force causes it to blow through the splined connection of the rotor shaft and input pinion. Near the end of the rotor shaft the mist passes through a hole in the rotor shaft wall and then reverses direction and flows through the aft rotor shaft roller bearing. It flows forward around the outside of the rotor shaft, through the forward rotor shaft thrust bearing and out of the oil slinger nut into the oil sump.

The system relief valve regulates system oil pressure from 15 to 40 psig by bypassing a portion of the pump output directly into the reduction drive housing. The bypassed oil returns to the sump by gravity flow.

3. COMPONENTS.

A. Oil Pump.

The gear-type oil pump consists of two gears pinned on shafts mounted inside a two-piece housing, which is secured in the reduction drive housing. One oil pump (driver gear) is pinned to the oil pump drive shaft. The other gear (driven gear) is pinned to the oil pump driven shaft. A third gear, the oil pump drive gear, is pinned and secured with a nut to the end of the pump drive shaft just outside the oil pump housing, and is driven by the reduction gear train.

B. Oil Filter.

The oil filter consists of a filter housing in the reduction drive, a nominal 10-micron, disposable filter element, and a bypass relief valve housing that serves as a cap for the filter element. The cap (relief valve housing) incorporates a spring-loaded, ball-type, bypass relief valve.

C. Oil Pressure Switch.

The oil pressure switch incorporates normally closed contacts that open an increasing oil pressure at 6 ± 1 psig. The contacts close on decreasing oil pressure at 6 ± 1 psig. After the engine is operating at or above 80 percent rated speed, decreasing oil pressure below 6 ± 1 psig closes the contacts in the switch and through electrical circuitry, illuminates a red lamp in the cockpit control panel to warn of a low oil pressure condition.

D. Oil Pressure Relief Valve.

The pressure relief valve contains a spring-loaded, ball-type relief valve internally mounted in the reduction drive housing. The valve regulates the system oil pressure at 15 to 40 psig by bypassing a portion of the pump output. The bypassed oil is returned to the sump.

E. Oil Separator Plates.

Two centrifugal oil separator plates are mounted on the sides of the accessory drive gear in the top of the reduction drive housing. The plates remove the oil from the air-oil mist in the reduction gearbox by centrifugal force before the air is vented to atmosphere.

F. Oil Jet Ring.

The oil jet ring is located in the bearing carrier assembly for the planetary gear system. The jet ring encircles the high-speed input pinion and provides three jets of oil that are directed at the mesh points of the input pinion and planetary gears. Two additional oil jets direct oil onto the Zerol bevel gears, and Zerol bevel gear shaft.

G. Oil Pan (Sump).

The engine oil pan (sump) is a five-pint capacity container. The oil pan is fastened to the bottom of the reduction drive housing with a quick-release V-type clamp. An O-ring between the oil pan and reduction drive housing prevents oil leakage.

"END"

APU OIL - MAINTENANCE PRACTICES

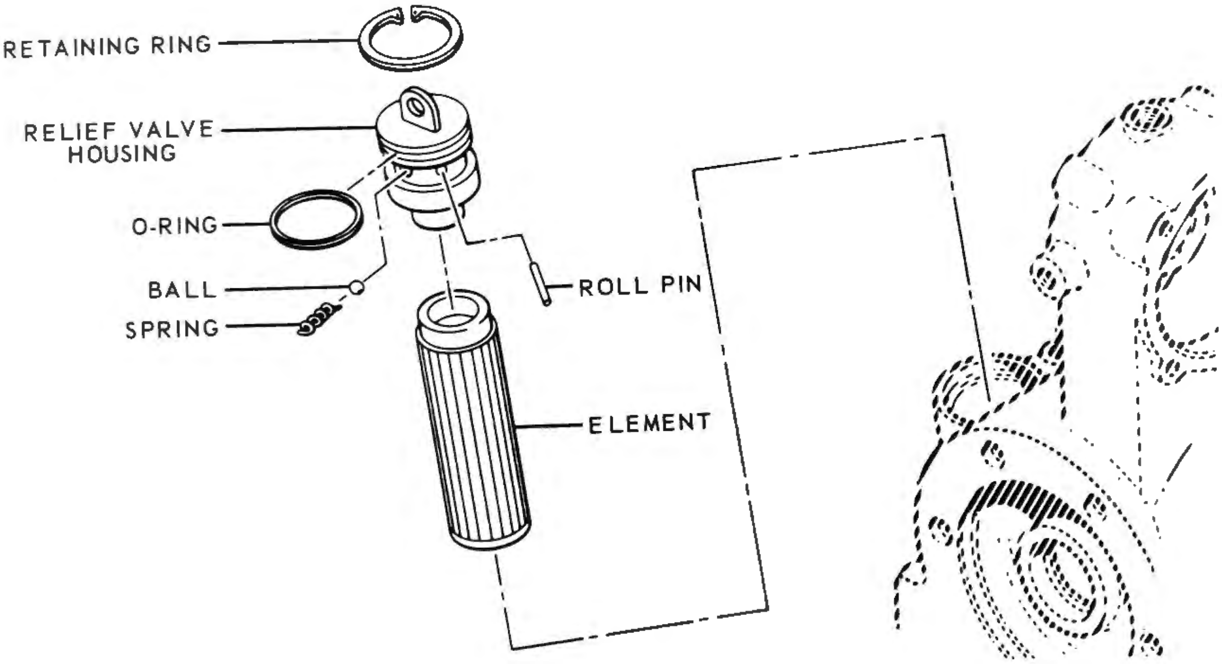
1. OIL FILTER ELEMENT.

A. Removal.

(1) Remove retaining ring securing relief valve housing (oil filter cap) to oil filter receptacle in reduction drive housing.
(2) Pull relief valve housing, O-ring, and element as a single unit from reduction drive housing. Remove and discard O-ring.
(3) Pull element, which is retained by an O-ring, from valve housing.
(4) To disassemble oil filter relief valve, use a drift punch or similar tool, and drive out roll pin from relief valve housing. Remove spring and ball.

B. Inspection.

(1) Check all oil passages in housing for restrictions.
(2) Check valve seat, valve, and spring for pits and corrosion.
(3) Remove restrictions from oil passages.
(4) Replace damaged parts.
(5) Install new filter element.



Oil Filter Disassembly
Figure 1

C. Installation.

(1) Insert ball and spring in relief valve housing; insert roll pin to keep ball and spring in place.
(2) Install filter element to valve housing; secure with new O-ring.
(3) Insert relief valve housing, O-ring, and element as a single unit into reduction drive housing.
(4) Secure relief valve housing (oil filter cap) to oil filter receptacle in reduction drive housing with a retaining ring.

2. OIL PRESSURE SWITCH.

A. Removal and Inspection.

(1) Disconnect electrical connector from oil pressure switch.
(2) Unscrew switch from reduction drive assembly. Remove and discard O-ring.
(3) Inspect condition of threads.
(4) Inspect switch for dents, cracks, and other visible damage.
(5) Replace switch if threads are stripped, pins are bent, or if there is other visible damage.
(6) Functionally check switch if suspected of being defective.

B. Installation.

(1) Install new O-ring; screw switch into reduction drive assembly.
(2) Connect electrical connector to oil pressure switch.
(3) Lockwire switch to nearest plug on oil filter housing with wire, MS20995C32.

3. OIL FILLER CAP AND DIPSTICK ASSEMBLY.

A. Removal.

(1) Remove oil filler cap and dipstick assembly by pressing down on cap and rotating it 1/4-turn counterclockwise.

NOTE: An O-ring, MS29561-020, fits in a groove on the shoulder of the filler cap. Do not replace this O-ring unless it is damaged.

(2) Unscrew base (body) from oil pan. Remove and discard O-ring.

B. Inspection.

(1) Inspect dipstick for loose fit and legibility of measurements.
(2) Inspect O-ring on shoulder of filler cap for damage.
(3) Remove and discard safety chain if installed.
(4) Irreparable damage to dipstick, cap, or base is cause for replacement.

C. Installation.

(1) Install new O-ring to base (body) and screw base into oil pan.

NOTE: An O-ring, MS29561-020, fits in a groove on the shoulder of the filler cap. Do not replace this O-ring unless it is damaged.

(2) Replace oil filler cap and dipstick assembly by pressing down on cap and rotating it 1/4-turn clockwise.

4. MAGNETIC PLUG.

A. Removal.

NOTE: The magnetic plug is threaded into the oil drain plug. Approximately one teaspoonful of lubricating oil will drain from the oil pan every time the magnetic plug is removed.

(1) Place a suitable container or rag beneath oil pan to catch small amount of oil that will drain when magnetic plug is removed.
(2) Remove magnetic plug from oil drain plug.
(3) Remove and discard O-ring installed between plugs.

B. Inspection.

(1) Inspect condition of threads.
(2) Inspect for metal particles adhering to magnetic end of plug by wiping across magnetic end with fingertips, and lightly rubbing oil between fingertips. If metal particles are present, turbine engine shall be returned to Solar for overhaul.

C. Installation.

(1) Install new O-ring, MS29561-010, between plugs.
(2) Install magnetic plug to oil drain plug.
(3) Lockwire magnetic plug to oil drain plug with wire conforming, MS20995C32.

"END"